ARM-94-001

Site Scientific Mission Plan for the Southern Great Plains CART Site

January-June 1994

Prepared for the U.S. Department of Energy under Contract W-31-109-ENG-38

Site Program Manager Office
Environmental Research Division
Argonne National Laboratory
Argonne, IL 60439

Distribution Category:
Environmental Sciences (UC-402)

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December 1993

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Work supported by United States Department of Energy,
Office of Energy Research,
Office of Health and Environmental Research

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ACKNOWLEDGMENTS

This research was supported by the Atmospheric Radiation Measurement Program of the Atmospheric and Climate Research Division, Office of Health and Environmental Research, Office of Energy Research, U.S. Department of Energy, under contract PNL 144880-A-Q1 at the Cooperative Institute for Mesoscale Meteorological Studies, The University of Oklahoma (Schneider and Lamb), and under contract W-31-109-Eng-38 at Argonne National Laboratory (Sisterson).

NOTATION

AER	Atmospheric and Environmental Research, Inc.
AERI	atmospherically emitted radiation interferometer
ARL	Air Resources Laboratory
ARM	Atmospheric Radiation Measurement
BBSS	balloon-borne sounding system
CART	Cloud and Radiation Testbed
CCN	cloud condensation nuclei
CST	Central Standard Time
CSU	Colorado State University
CU	Colorado University
DA	data assimilation
DMT	Data Management Team
DOA	Department of Agriculture
EBBR	energy balance Bowen ratio
EC	eddy correlation
EML	Environmental Measurements Laboratory
EOP	experiment operations plan
EST	Experiment Support Team
FDDA	four-dimensional data assimilation
FSL	Forecast Systems Laboratory
GCIP	GEWEX Continental-Scale International Project
GCSS	GEWEX Cloud System Study
GEWEX	Global Energy and Water Cycle Experiment
GIST	GEWEX Integrated System Test
GMS	general measurement strategies
GOES	geostationary orbiting Earth satellite
GPS	global positioning system
GSFC	Goddard Space Flight Center
GVaP	GEWEX Water Vapor Project
HD	hierarchical diagnosis
IDP	Instrument Development Program
IOP	Intensive Observation Period
IR	infrared
IRF	instantaneous radiative flux
ISLSCP	International Satellite Land-Surface Climatology Project
ISS	integrated sounding system
IT	Instrument Team
LBLRTM	line-by-line radiative transfer model
LST	local standard time
MFRSR	multifilter rotating shadowband radiometer
MWR	microwave radiometer
NASA	National Aeronautics and Space Administration
NCAR	National Center for Atmospheric Research
NCSU	North Carolina State University

NOTATION (Cont.)

NIP	normal-incidence pyrheliometer
NIST	National Institute of Standards and Technology
NOAA	National Oceanic and Atmospheric Administration
NREL	National Renewable Energy Laboratory
NSSL	National Severe Storms Laboratory
NWS	National Weather Service
PAM	Portable Automated Mesonet
PNL	Pacific Northwest Laboratory
PSU	Pennsylvania State University
QME	quality measurement experiment
RASS	radio acoustic sounding system
SCM	single-column model
SDS	site data system
SGP	Southern Great Plains
SIROS	solar and infrared radiation observing station
SMOS	surface meteorological observation station
SNL	Sandia National Laboratory
SORTI	solar radiance transmission interferometer
SST	Site Scientist Team
TOA	top of atmosphere
UAV	unmanned aerospace vehicle
UM	University of Massachussetts
UNAVCO	University NAVSTAR Consortium
UTC	universal time coordinates
UU	University of Utah
UV	ultraviolet
UW	University of Wisconsin
VORTEX	Verification of the Origins of Rotation in Tornadoes Experiment
WPL	Wave Propagation Laboratory
WSI	whole-sky imager
3-D	three dimensional

SITE SCIENTIFIC MISSION PLAN
FOR THE SOUTHERN GREAT PLAINS CART SITE
JANUARY-JUNE 1994

1 INTRODUCTION

The Southern Great Plains (SGP) Cloud and Radiation Testbed (CART) site is designed to help satisfy the data needs of the Atmospheric Radiation Measurement (ARM) Program Science Team. This document defines the scientific priorities for site activities during the six months beginning on January 1, 1994, and also looks forward in lesser detail to subsequent six-month periods. The primary purpose of this *Site Scientific Mission Plan* is to provide guidance for the development of plans for site operations. It also provides information on current plans to the ARM Functional Teams (Management Team, Experiment Support Team, Operations Team, Data Management Team, Instrument Team, and Campaign Team), and it serves to disseminate the plans more generally within the ARM Program and among the Science Team. This document includes a description of the site's operational status and the primary envisaged site activities, together with information concerning approved and proposed Intensive Observation Periods. Amendments will be prepared and distributed whenever the content changes by more than 30% within a six-month period. The primary users of this document are the site operator, the site scientist, the Science Team through the ARM Program Science Director, the ARM Program Experiment Center, and the aforementioned ARM Program Functional Teams. This plan is a living document that will be updated and reissued every six months as the observational facilities are developed, tested, and augmented and as priorities are adjusted in response to developments in scientific planning and understanding.

2 PRIORITIES FOR SITE ACTIVITIES

In descending order, we rank the priorities of site activities for January-June 1994 as follows:

1. Establish routine site operations.

2. Support all data quality assurance efforts, including implementation of quality measurement experiments.

3. Plan and implement key Intensive Observation Periods.

4. Support the Instrument Development Program.

5. Plan and implement campaigns.

Within this ranking, the differences in relative importance between adjacent items are not large, but the top priority is clearly routine operations. The categorization is also somewhat artificial, because many site activities are multipurpose. For example, Intensive Observation Period (IOP) activities can simultaneously support Science Team, Instrument Development Program (IDP), and campaign requirements. Even so, this ranking reflects our scientific assessment of the activities that should receive the most support during this period. The SGP site and the supporting structures within the ARM Program are still being consolidated. Progress to date has been significant, but substantial work remains to bring this facility and the data stream to full maturity. At the central facility, the calibration and aerosol trailers await development; a number of instruments need to be installed, modified, or tested; and the site data system has yet to become operational. The suite of boundary and extended facilities needs to be completed, and decisions must be made about the auxiliary facilities. Methodologies for developing scientifically sound and cost-effective plans for IOPs and campaigns are being developed and tested. Data quality assurance efforts are underway, but in their infancy. The IOPs will focus on providing critical data on an episodic basis to the Science Team, as well as field support for instrument development and testing. Simply stated, the primary scientific goal for this period is the same as the goal for the last six months: translation of site implementation activities into routine data streams of known quality for as many parameters as possible.

3 SUMMARY OF SCIENTIFIC GOALS

The primary goal of the SGP CART site activities is to produce data adequate to support significant research addressing the ARM Program objectives. These overall objectives, as paraphrased from the *ARM Program Plan*, are the following:

- To describe the radiative energy flux profile of the clear and cloudy atmosphere
- To understand the processes determining the flux profile
- To parameterize the processes determining the flux profile for incorporation into general circulation models

To address these scientific issues, an empirical data set must be developed that includes observations of the evolution of the radiative state of the column of air over the entire 350-km x 400-km SGP CART site, as well as the processes that control that radiative state, in sufficient detail and quality to support the investigations proposed by the ARM Science Team. This data set includes measurements of radiative fluxes (solar and infrared) and the advective and surface fluxes of moisture, heat, and momentum occurring within the column and across its boundaries. Other entities to be described are cloud types, composition, and distribution (depth, fractional coverage, and layering); thermodynamic properties of the columnar air mass (temperature, pressure, concentrations of all three phases of water); the state and characteristics of the underlying surface (the lower boundary condition); processes within the column that create or modify all of these characteristics (including precipitation, evaporation, and the generation of condensation nuclei); and radiatively significant particulates, aerosols, and gases. Basic, continuous observations must be made as often as is feasible within budgetary constraints. For limited time periods, these observations will be supplemented by directed IOPs providing higher resolution or difficult-to-obtain *in situ* data.

Beyond simply providing the data streams, it is imperative to determine their character and quality as early as possible in the observational program. This evaluation will provide the basic operational understanding of the data necessary for an ongoing program of such scope. Although there will be both reason and ample opportunity to develop a further understanding of the ARM observations over the course of the program, it is important to investigate and ensure the data quality as soon as possible. In this regard, early and definitive quality measurement experiments (QMEs) will establish confidence in the measurements.

The SGP CART site is the first of several global locations chosen and instrumented for data collection. As summarized in a draft report by Sisterson and Barr, the scientific issues to be addressed by using data from a midlatitude continental CART observatory include the following:

- Radiative transfer under conditions of clear sky and general cloudiness

- Scattering and absorption in cloudy atmospheres

- Cloud formation, maintenance, and dissipation

- Nonradiative flux parameterizations

- The role of surface physical and vegetative properties in the column energy balance

- Other complications in the radiative balance in the atmosphere, particularly those due to aerosols, cloud condensation nuclei (CCN), and cloud-aerosol radiative interactions

- Feedback processes between different phenomena and different domains

The variety, density, and atmospheric volumetric coverage of the SGP instrumentation will be the most comprehensive at any ARM site, and the SGP site will experience a wider variety of atmospheric conditions than any other ARM site. The resulting data will support a greater range and depth of scientific investigation than data from any other location, making it imperative for the ARM Program to develop and maintain a high-quality, continuous data stream from the SGP site.

In the process of distilling the measurements required by the Science Team proposals, the Experiment Support Team (EST) and the Science Director developed a set of general measurement strategies (GMS), which represent groups of experiments requiring measurements with similar characteristics. The initial GMS are designed to quantify the instantaneous radiative flux (IRF) and to support the requirements of the single-column model (SCM) data assimilation (DA) and hierarchical diagnosis (HD) research. The EST, Instrument Team (IT), and others have established a set of critical measurements that has driven much of the SGP site development to date. The EST documented these measurements in 1992 and continues to work with the IT to prioritize the scheduling of instrument deployment. Because the site implementation has been phased, IRF measurements began first. They have been followed by the initiation of episodic measurements designed to support the SCM, DA, and HD experiments. This six-month period will include activities that will support a major portion of each of the GMS.

Budget limitations and procurement delays have slowed the site development somewhat and will modulate the completion of the site. The emphasis in this six-month period will be on consolidating the existing suite of instruments and supporting systems and resolving any associated data quality issues. A design review process has been initiated for new systems scheduled for the site (including the calibration and aerosol facilities), which will address installation, operational, safety, and quality issues. Our ability to meet the long-term observational needs of the Science Team will depend on the continued development, acquisition, and deployment of instruments (especially at the boundary and extended facilities), as well as careful orchestration of IOPs and collaborative campaigns during the next few years. Instruments will be acquired and installed (especially the optical, aerosol, and calibration instrumentation), while the IDP research will continue to search for the best way to profile water vapor automatically (with day-capable Raman lidar or passive microwave systems) and to define the clouds (ceilometers, whole-sky imaging, radars, and lidars).

The winter, spring, and early summer at the SGP site typically include a wide range of conditions ¾ from cold, clear, and calm conditions interspersed with snow, blizzards, or ice storms; through organized convective activity producing significant precipitation and associated stratocumulus and cirrus decks; to high humidity, heat, and haze. In response to the GMS workshops, break-out sessions at the March 1993 Science Team meeting, and subsequent surveys by the EST, site activities during January-June 1994 will expand to include a wider suite of continuous measurements, including an enhanced rawinsonde launch schedule. Special operations will include five IOPs, each of which will provide unique sets of measurements.

We will continue the interim suite of basic IRF measurements, including limited sky imagery, cloud base observations, and hourly visual observations of sky conditions above the central facility during operator hours. Beginning in February, a second daily balloon-borne sounding system (BBSS) launch will be initiated at the central facility, specifically to coincide with the overpass of one of two polar-orbiting satellites as requested by the IRF group. Other daily launches at the central facility will be added as the operating budget allows (Section 4.2.6). The atmospherically emitted radiation interferometer (AERI), the Belfort laser ceilometer and (we hope) the Spinhirne micropulse lidar ceilometer, and the interim whole-sky imaging system, together with continuous operation of the multifilter rotating shadowband radiometers (MFRSRs) and microwave radiometers (MWRs), will continue to be important elements in the IRF measurements.

During this six-month period, we will also begin to address SCM, DA, and HD measurement needs with eddy correlation measurements at the central facility and with radar and acoustic profiling at two frequencies; surface data collection from extended facilities; and periods of continuous measurement of integrated liquid and cloud water, plus temperature, humidity, and wind profiles from the BBSS at the boundary facilities. Seasonal IOPs to support the SCM research will begin in January and continue in April. Both of these IOPs will involve 21 days of synchronized rawinsonde launches from the central and boundary facilities every three hours. An IOP for *in situ* observation of cloud optical properties has been deferred until funding and logistic considerations converge.

Site operations will continue to support activities necessary for the IDP, including a spring IOP specifically designed to produce verifying *in situ* data on cloud physical properties for a variety of cloud remote sensing systems; field adaptation of the AERI; and field testing of the solar radiance transmission interferometer (SORTI), the ultraviolet (UV) spectral radiometer, and the Spinhirne micropulse lidar ceilometer.

In summary, our goal for this six-month period is to provide the Science Team with a suite of measurements that will support a wider range of research, while establishing solid instrument calibration and maintenance procedures and continuing the series of QMEs. The data quality assurance effort is central to the success of the entire program.

4 ESTABLISHMENT OF ROUTINE SITE OPERATIONS

The *ARM Program Plan* states that the comparison of model results with observations will continue throughout the lifetime of the site. This approach is the primary rationale for the establishment of decade-long routine operations at the SGP CART site. This strategy is followed in the experimental designs of the individual Science Team members. The experiment operations plans (EOPs) are a joint effort between the EST and Science Team members to reflect the experimental designs of individual Science Team members. This site mission report collectively captures Science Team members' data stream requirements. The EOPs are sorted into the four GMS categories. The location and configuration of the various facilities within the SGP CART site, the instrumentation, the operation of the site, and budget considerations are optimized to meet the objectives of the GMS categories.

The overwhelming majority of the measurement with the highest priority on which the extant experimental designs are based, are regular (i.e., routine) observations. Continuous observations are also specified in the *ARM Program Plan* because of their utility in offsetting the lack of complete geographic coverage of the CART site. Implicit in the philosophy of choosing just a few observational locations was the understanding that long time series of data could sample enough of the natural variability to constitute a useful surrogate for spatial statistics, both within and beyond the bounds of the CART site. The heart of any statistical study is an uninterrupted sequence of high-quality observations; hence, developing and maintaining a robust observational facility as soon as possible is crucial.

Scientifically and logistically, routine operations will serve as the basis and background for all nonroutine operations, including QMEs, instrument development activities, IOPs, and collaborative campaigns directed toward obtaining difficult-to-gather or expensive *in situ* data. Consequently, development and validation of the basic observations retains top priority. Site development has progressed sufficiently to support several IOPs during this six-month period, both for field testing and validation of prototype instruments and to fill unmet measurement needs.

The Site Scientist Team (SST) will play a role in the establishment of routine operations, providing guidance to the site operations manager and his staff on scientific matters related to the data stream, answering questions from operations personnel concerning potential instrument problems, reviewing instrument maintenance and calibration schedules and procedures, reviewing designs for infrastructure supporting new instruments, contributing to the design of the standard operating procedure, reviewing and developing plans for special operations, and helping to establish forecast support for routine and special operations. The SST will generally oversee the quality control effort at the CART site, a continuous activity that includes daily monitoring of the CART data streams in collaboration with the staff at the central facility and the development of a data quality assurance plan that will address the data originating at the SGP site.

During this six-month period, a high priority of the SST will again be comparison of similar data streams from different instrument packages, a natural and obvious complement to the efforts of the instrument mentors. A number of QMEs will be developed by instrument mentors, the SST, and the EST and then conducted by employing routine observations. Examples include (1) comparison of water vapor profiles retrieved from the MWR integrated vapor with the BBSS moisture profile; (2) comparison of calculated brightness temperatures (using the line-by-line radiative transfer model [LBLRTM]) at the specific wave numbers at which the MWR operates to the brightness temperatures observed by the MWR; (3) comparison of the cloud base heights derived from the Belfort and Spinhirne ceilometers with the cloud base height derived from the whole-sky imager (WSI); (4) intercomparison of the observed and calculated broadband radiative surface fluxes; (5) virtual temperature and velocity profiles from the BBSS and the 915-and 50-MHz profilers; (6) temperature, humidity, and pressure measurements from the surface meteorological observation station (SMOS), the 60-m tower, and the energy balance Bowen ratio (EBBR) system; and (7) momentum, heat, and moisture fluxes derived from the EBBR and eddy correlation (EC) systems. These studies will refine or validate the vendor-specified operating ranges, precision, and accuracy of the CART instruments. A more subtle task will be the comparison of observations of different parameters to determine if they make physical sense in the context of changing conditions. This work will be inspired by the daily monitoring of the data stream and the QMEs already mentioned. Once the first round of QMEs is well underway, the efforts of the SST will shift to dissemination of the QME results, to new instruments and more difficult QMEs that require special observations or longer time series, and (in a broader sense) to the planning and implementation of IOPs.

4.1 Routine Operations on January 1, 1994

4.1.1 Instruments and Observational Systems

The accomplishments of the site development efforts are most evident at the central facility, with its functioning power and data infrastructure and an impressive array of instruments. Nine extended facilities have at least a partial suite of instruments in place, and work on the boundary facilities has begun. Figure 1 is a map of the SGP site highlighting the locations of the developed extended and boundary facilities. The systems and instruments in place are summarized in Tables 1 and 2. The auxiliary facilities, which are intended to be the base for the three-dimensional observations of the cloud field over the central facility, will not be developed until plans for whole-sky imaging, cloud radars, and lidars are more mature.

4.1.2 Launch Schedule for BBSS

Until the full suite of remote-sensing systems is deployed to perform deep, detailed wind, temperature, and moisture soundings of the troposphere under a wide range of conditions, the BBSS will continue to be an expensive workhorse because of the cost of expendables and manpower associated with an ambitious rawinsonde launch schedule. The number of BBSS launches sitewide should eventually be reduced to a minimum needed to support routine cross checks on the remotely sensed measurements, but we are a number of years from that goal. At the beginning of this period, because of budgetary constraints and the continuing site development activities, the launches will occur only once per weekday at the central facility at 1330 CST (1930 UTC). This launch time was originally chosen both to characterize the deepest boundary layer and to coordinate approximately with some afternoon satellite overpasses. In direct response to definitions of Science Team requirements (Appendices A and B), the frequency of routine launches will be increased at the central facility during this six-month period, and a schedule of launches at the boundary facilities will be initiated (see Section 4.2.6).

4.1.3 Observations, Measurements, and External Data

The observations being delivered to the Experiment Center from the SGP CART site as of November 11, 1993, are summarized in Table 3. Platforms listed as "NOT available" are undergoing evaluation. The other instruments operating at the site (Table 1) that are not in Table-3 either are still under evaluation by the instrument mentors or are awaiting the creation of the data intake modules necessary to add their data to the SGP data stream.

The measurements being produced at the Experiment Center as of November 11, 1993, for distribution to the Science Team are listed in Table 4. This summary includes both the measurements derived from the SGP CART site data and the data streams from sources external to ARM (e.g., the gridded data from the National Weather Service's [NWS's] Nested Grid Model [NGM]). Table 5 lists the external data that currently supplement the SGP site data. Tables 3-5

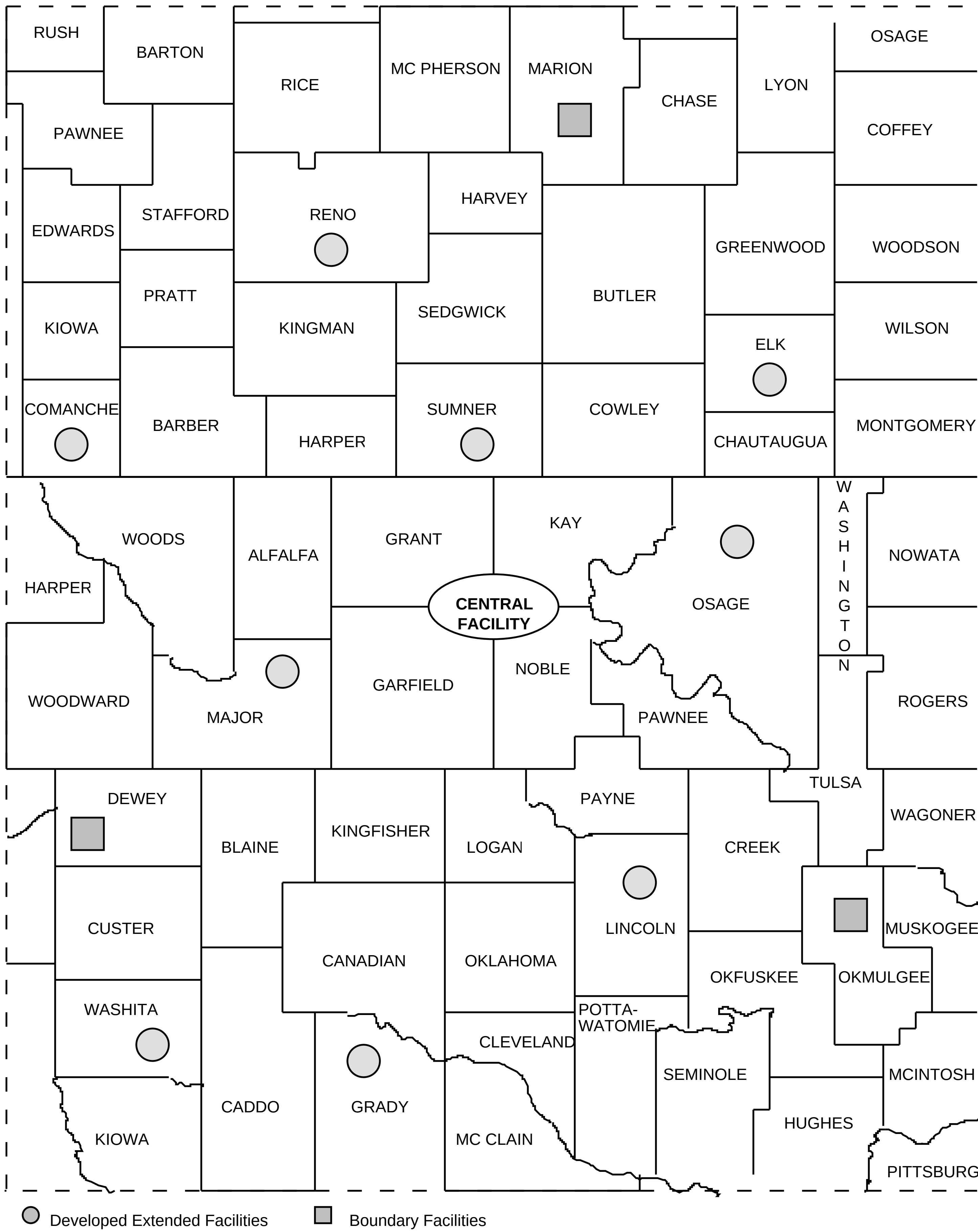

FIGURE 1 Overall View of the SGP CART Site

TABLE 1 Instruments and Observational Systems in Place at the Central, Boundary, and Auxiliary Facilities on January 1, 1994

Central facility

Radiometric Observations

- AERI
- SORTI (limited operations in January and February during the Winter SCM IOP)
- Interim SIROS (solar and infrared observing station)
  - Pyranometer (ventilated)
  - Pyranometer (shaded, ventilated)
  - Pyrgeometer (shaded, ventilated)
  - Normal-incidence pyrheliometer (NIP) on tracker
  - MFRSR
- SIROS
  - Pyranometer (ventilated)
  - Pyrgeometer (unshaded,[a] ventilated)
  - NIP on tracker
  - MFRSR

Wind, Temperature, and Humidity Sounding Systems

- BBSS
- 915-MHz profiler with RASS (radio acoustic sounding system)
- 50-MHz profiler with RASS
- MWR
- Heimann infrared thermometer

Cloud Observations

- Interim whole-sky imager
- Belfort laser (interim) ceilometer
- Micropulse lidar (IDP) ceilometer

Others

- SMOS
- EBBR
- Temperature and humidity probes at 60 m on tower

Boundary Facilities

Limited implementation (temporary fielding of BBSSes for IOPs but continuous operation of the MWR) at Hillsboro, Kansas; Vici, Oklahoma; and Morris, Oklahoma

Auxiliary Facilities

None in preparation

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[a] Solar tracking shade to be added as soon as possible.

TABLE 2 Instruments and Observational Systems in Place at the Extended Facilities on January 1, 1994[a]

Location	SMOS	SIROS	EBBR	EC	Data Intake
Kansas					
Ashton	X	X	X	-	Coded switch
Coldwater	X	*	X	-	EBBR by modem, SMOS by diskette
Plevna	*	*	X	-	Modem
Elk Falls	*	*	X	-	Diskette
Tyro	-	*	-	*	*
Towanda	*	*	-	*	*
Larned	*	*	-	*	*
LeRoy	*	*	-	*	*
Hesston	*	*	-	*	*
Hillsboro	-	*	*	-	*
Oklahoma					
Ringwood	X	X	X	-	Coded switch
Okmulgee	*	*	-	*	*
Meeker	X	*	X	-	EBBR by modem, SMOS by diskette
Cordell	-	*	X	-	Modem
El Reno	-	*	*	-	*
Pawhuska	-	*	X	-	Diskette
Vici	-	*	-	*	*
Morris	-	*	*	-	*
Ft. Cobb	-	*	-	*	*
Cyril	*	*	-	*	*
Byron	*	*	-	*	*
Cement[b]	-	-	X	-	Modem

[a] The central facility includes the complement of instruments at an extended facility. These are listed in Table 1, and are not repeated here. X means installed, * means planned for installation, - means no installation currently planned, "diskette" means data are retrieved manually on diskette, "modem" means data are retrieved remotely by telephone, "coded switch" means data are retrieved automatically by computer through coded switches. All sites will eventually transfer data by coded switches to the central facility. Eight of the sites are co-located with either an Oklahoma Mesonet or a National Weather Service (NWS) site, so that a SMOS would be redundant and is not planned. Each site will have either an EBBR (over pasture) or an EC (over cropland) system.

[b] Temporary facility to support the 1994 GEWEX (Global Energy and Water Cycle Experiment) study.

TABLE 3 CART Observation Status on November 11, 1993

Observation	Platform	Comments
From the BBSS		
Sonde temperature profile	sgpsondeC1.al	Available
Sonde relative humidity profile	sgpsondeC1.al	Available
Sonde pressure profile	sgpsondeC1.al	Available
Sonde wind speed profile	sgpsondeC1.al	Available
Sonde wind direction profile	sgpsondeC1.al	Available
From the MWR		
Column-integrated precipitable water vapor	sgpmwrlosC1.al	Available
Column-integrated liquid water path	sgpmwrlosC1.al	Available
23.8-GHz brightness temperature	sgpmwrlosC1.al	Available
31.4-GHz brightness temperature	sgpmwrlosC1.al	Available
Infrared (9.5-11.5 µm) sky temperature	sgpmwrlosC1.al	Available[a]
From the AERI		
Wave number (520-1800 cm^{-1})	sgpaerich1C1.al	Available
Mean infrared radiance spectra ensemble	sgpaerich1C1.al	Available
Standard deviation of spectra ensemble	sgpaerich1C1.al	Available
Wave number (1800-2725 cm^{-1})	sgpaerich1C1.al	Available
Mean infrared radiance spectra ensemble	sgpaerich1C1.al	Available
Standard deviation of spectra ensemble	sgpaerich1C1.al	Available
Mean radiance at 675-680, 700-705, 985-990, 2295-2300, 2282-2287, 2510-2515 cm^{-1}	sgpaerisummaryC1.al	Available
Standard deviation of the radiance at 675-680, 700-705, 985-990, 2295-2300, 2282-2287, 2510-2515 cm^{-1}	sgpaerisummaryC1.al	Available
Brightness temperature at 675-680, 700-705, 985-990, 2295-2300, 2282-2287, 2510-2515 cm^{-1}	sgpaerisummaryC1.al	Available
From the EBBR		
Sensible heat flux to surface	sgp30ebbrE4.al	Available[a]
Latent heat flux to surface	sgp30ebbrE4.al	Available[a]
Net radiation flux to surface	sgp30ebbrE4.al	Available[a]
Soil heat flux to surface	sgp30ebbrE4.al	Available[a]
Top and bottom temperatures	sgp30ebbrE4.al	Available[a]
Top and bottom relative humidities	sgp30ebbrE4.al	Available
Top and bottom vapor pressures	sgp30ebbrE4.al	Available[a]
Atmospheric pressure	sgp30ebbrE4.al	Available[a]
Soil moistures at five points	sgp30ebbrE4.al	Available[a]
Soil temperatures at five points	sgp30ebbrE4.al	Available[a]
Scalar and resultant wind speeds	sgp30ebbrE4.al	Available[a]
Mean and standard deviation of wind direction	sgp30ebbrE4.al	Available[a]

TABLE 3 (Cont.)

Observation	Platform	Comments
From the SMOS		
Mean and standard deviation of wind speed	sgp30smosE4.al	Available[a]
Mean and standard deviation of wind direction	sgp30smosE4.al	Available[a]
Vector-averaged wind speed	sgp30smosE4.al	Available[a]
Mean and standard deviation of temperature	sgp30smosE4.al	Available[a]
Mean and standard deviation of relative humidity	sgp30smosE4.al	Available[a]
Vapor pressure	sgp30smosE4.al	Available[a]
Mean and standard deviation of barometric pressure	sgp30smosE4.al	Available[a]
Snow depth	sgp30smosE4.al	Available[a]
Precipitation total	sgp30smosE4.al	Available[a]
From the SIROS		
Direct beam-normal solar irradiance	sgpbsrnC1.al	Available[a]
Downwelling diffuse solar irradiance	sgpbsrnC1.al	Available[a]
Downwelling hemispherical solar irradiance	sgpbsrnC1.al	Available[a]
Upwelling hemispherical solar irradiance	sgpbsrnC1.al	Available[a]
Downwelling hemispherical infrared radiance	sgpbsrnC1.al	Available[a]
Hemispheric downward solar irradiance (415, 500, 610, 665, 862, and 940 nm)	sgpbsrnC1.al	Available[a]
Hemispherical downward total solar irradiance	sgpbsrnC1.al	Available[a]
Diffuse hemispherical downward solar irradiance (415, 500, 610, 665, 862, and 940 nm)	sgpbsrnC1.al	Available[a]
Diffuse hemispherical downward total solar irradiance	sgpbsrnC1.al	Available[a]
Direct beam-normal solar irradiance (415, 500, 610, 665, 862, and 940 nm)	sgpbsrnC1.al	Available[a]
Direct beam-normal total solar irradiance	sgpbsrnC1.al	Available[a]
From the Belfort Ceilometer		
Cloud base height	—	Available[a]
From the Profiling Radars		
915-MHz wind speed profile	—	Available[a]
915-MHz wind direction profile	—	Available[a]
915-MHz virtual temperature profile	—	Available[a]
50-MHz wind speed profile	—	NOT available
50-MHz wind direction profile	—	NOT available
50-MHz virtual temperature profile	—	NOT available

TABLE 3 (Cont.)

Observation	Platform	Comments
From Future Instruments		
Cloud base height (Spinhirne micropulse lidar)	—	IDP Test 12/93
UV spectral radiometer	—	IDP Test 1/94
Interim whole-sky imager	—	Available[a]

[a] Expected to be available in January 1994.

TABLE 4 CART Measurement Status on November 11, 1993

Measurement	Platform	Comments
From the SIROS		
Direct beam-normal solar irradiance	sgpbsrncalcC1.c1	Available
Calculated downward hemispherical diffuse solar irradiance	sgpbsrncalcC1.c1	Available
Downwelling hemispherical solar irradiance	sgpbsrncalcC1.c1	Available
Solar zenith angle used in calculation	sgpbsrncalcC1.c1	Available
From the MWR		
Average (5-min) column-integrated water vapor	sgp5mwravgC1.c1	Available
Average (5-min) column-integrated liquid water	sgp5mwravgC1.c1	Available
Average (5-min) blackbody equivalent brightness temperature	sgp5mwravgC1.c1	Available
Water vapor density profile	sgpmwrprofC1.c1	Available[a]
From the MFRSR		
Optical depth (415, 500, 610, 665, 862, 940 nm)	rsr-langley	Available[a]
Solar constant (415, 500, 610, 665, 862, 940 nm)	rsr-langley	Available[a]
Optical depth root mean square error (415, 500, 610, 665, 862, 940 nm)	rsr-langley	Available[a]
From Science Team Algorithms		
Reflected solar flux at top of atmosphere (TOA) (Cess algorithm)	toa-refflx	Available[a]
Input for LBLRTM (line-by-line radiative transfer model)	lblrtm.input	Available[a]
Output from LBLRTM (infrared spectral irradiance at 520-3020 cm $^{-1}$)	lblrtm.output	Available[a]
Difference of observations and calculations of infrared irradiances	qme-aerilbldiff	Available[a]
Map of wave number to physical process	qme-MLSspecmap	Available[a]
Statistical summary of radiance residuals	qme-aerilbl	Available
Statistical summary of hourly AERI radiance	qme-aerimeans	Available

[a] Expected to be available in January 1994.

TABLE 5 CART External Data Status on November 11, 1993

Measurement	Platform	Comments
From Satellites		
GOES (geostationary orbiting Earth satellite) visible brightness	goesvis	Available
GOES IR (infrared) radiance (11.2 µm)	geosir	Available
AVHRR visible albedo (two channels)	avhrr	Available
AVHRR IR radiance (three channels)	avhrr	Available
GOES IR temperature (12.7, 11.2, 6.7 µm)	goesir	Available
AVHRR IR temperature	avhrr	Available
Meteosat (visible) for eastern United States	meteosatvis	Available[a]
Meteosat (infrared) for eastern United States	meteosatvir	Available[a]
From the Smoothed Nested Grid Model Data Products		
Temperature (3-D [three dimensional])	ngm250	Available
Relative humidity (3-D)	ngm250	Available
Horizontal wind components (3-D)	ngm250	Available
Vertical (omega) wind component (3-D)	ngm250	Available
Geopotential heights (3-D)	ngm250	Available
Surface and tropopause pressure (2-D)	ngm250	Available
12-hour precipitation (2-D)	ngm250	Available
Surface pressure (reduced to sea level)	ngm250derived	Available
Tropopause pressure	ngm250derived	Available
Tropopause temperature	ngm250derived	Available
Temperature (T)	ngm250derived	Available
- (u*dT/dx + v*dT/dy)	ngm250derived	Available
Water vapor mixing ratio	ngm250derived	Available
- (u*dq/dx + v*dq/dy)	ngm250derived	Available
Horizontal wind components (u, v)	ngm250derived	Available
(du/dx + dv/dy)	ngm250derived	Available
- (u*du/dx + v*dv/dy) and - (u*dv/dx + v*dv/dy)	ngm250derived	Available
Geopotential height (Z)	ngm250derived	Available
dZ/dx and dZ/dy	ngm250derived	Available
d2T/dx2, d2T/dy2	ngm250derived	Available
d2q/dx2, d2q/dy2	ngm250derived	Available
d2u/dx2, d2u/dy2	ngm250derived	Available
d2v/dx2, d2v/dy2	ngm250derived	Available
From the Forecast Systems Laboratory Maps Model		
Gridded meteorological fields (eight daily) of height, temperature, relative humidity, and horizontal wind components, every 25 hPa from the surface to 100 hPa, covering most of North America (subsets also available)	maps60	Available[a]
Derived variables from Mesoscale Analysis and Prediction System data similar to those in ngm250derived	maps60derived	Available[a]

TABLE 5 (Cont.)

Measurement	Platform	Comments
From the National Meteorological Center ETA Model		
Gridded meteorological fields (four daily) of height, temperature, relative humidity, and horizontal wind components, every 50 hPa from the surface to 100 hPa, covering most of North America (subsets also available)	eta90	Available[a]
Derived variables from ETA data similar to those in ngm250derived	eta90derived	Available[a]
From the National Oceanic and Atmospheric Administration (NOAA) Wind Profiler Demonstration Network		
Profile of wind components	—	Available[a]
Derived variables from NOAA profilers, especially divergence	—	Available[a]
From Shortwave GOES Data Provided by Gautier		
Shortwave surface irradiance	—	?
Shortwave directional reflectance ("albedo")	—	?
Shortwave cloud transmittance	—	?
From the National Weather Service		
Surface hourly observations	nws-sfc	Available[a]
Upper air observations	nws-upair	Available[a]
From the Kansas Surface Mesonetwork		
Hourly observations of air temperature, relative humidity, wind direction, wind speed, total solar radiance, total rainfall, and 10-cm soil temperature	ka-mesonet	Available[a]
From the Oklahoma Mesonetwork		
Hourly observations of air temperature, relative humidity, wind direction, wind speed, total solar radiance, total rainfall, and 5- and 10-cm soil temperature	ok-mesonet	Available

[a] Expected to be available in January 1994.

are a reflection of the data streams required for experimental designs and EOPs. Separate documentation of the experimental designs is given in the *Reference Manual for CART Experiment Design: Documentation of Measurements According to General Measurement Strategies* (January 31, 1992, Version 1.0) that is distributed by the Modeling Team leader at Lawrence Livermore National Laboratory, Livermore, California 94550.

4.2 Site Development Activities

4.2.1 Facilities

Much of the essential infrastructure at the central facility is complete, including the power and fiber optic data network. Several support systems require further development, however. These include the three areas designed to host IDP or visiting instruments at the central facility during IOPs and campaigns. IDP 1 is south of the calibration trailer, IDP 2 is west of the optical trailer, and IDP 3 was recently scheduled for relocation about 50 m east of the staging trailer, along the edge of the road. Although power and telephone lines and the fiber optic network have termination points close to IDP 1 and IDP 2, all utilities need to be brought to the location of IDP 3. IDP 1 and 2 have the pad areas in place, but IDP 3 will require significant pad preparation. About 0.25 mi of unimproved roadway connects IDP 3 and the all-weather road to the parking lot. This unimproved segment must be upgraded to all-weather status. IDP 3 also needs to have three-phase power installed to support any visiting facilities requiring it. Single-phase power will also be available at IDP 3. All three IDP locations need to be implemented before the central facility can host the Cloud Remote Sensing IOP in April and May.

The AERI is installed in the optical trailer, but problems relative to an automatic liquid nitrogen supply await resolution during this six-month period. The resulting impact to site operations has limited operation of the AERI until a satisfactory solution is found. Beginning in December, site operations will hand-fill the AERI during normal operator hours (once each morning). During the SCM IOPs, site operators will hand-fill the AERI with liquid nitrogen at the beginning of each shift.

The SORTI was installed in the optical trailer for a test period in December that carried over into the Winter SCM IOP. The Spinhirne micropulse lidar has been operating at the optical trailer, and the Belfort ceilometer is operating about 3 m east of the optical trailer.

Initial design requirements were reviewed (October 1993) for the calibration platform deck and wiring of the calibration trailer. Procedures are being developed to identify the number of sensors required, the required frequency of calibration for all radiometers at the SGP site, the frequency of sensor changeouts, and a methodology for tracking all sensors. The calibration trailer is tentatively scheduled for implementation in mid to late summer 1994.

Plans for the aerosol intake stack and other structures in the aerosol trailer were reviewed in December 1993. Plans call for implementation of the facility in the early summer of 1994 (see Table 6).

The site data system (SDS) will continue to evolve during this six-month period. Automated electronic data transfers (via telephone, controlled by data switches) from all extended and boundary facility instruments need to be developed, tested, and implemented. We expect the SDS to require one or more upgrades to be able to support this critical expansion in capabilities. Further work is also needed to support routine operations, particularly for assessment of instrument performance and data transfer, including a broader suite of data display capabilities. Once the SDS is near completion, procedures for system management and maintenance need to be written and transferred to site operations.

The nine current extended facilities will be completed, and (operations budget permitting) six additional extended facilities will be established, as indicated in Table 7. The temporary EBBR near Cement in Grady County, Oklahoma, will not be moved to the El Reno, Oklahoma, site until summer, as requested, to support the April field activities of the GEWEX (Global Energy and Water Cycle Experiment) GCIP (GEWEX Continental-Scale International Project) and GCSS (GEWEX Cloud Study System) in the Little Washita watershed.

The first three boundary facilities will initially support a BBSS and an MWR, in close proximity to the National Oceanic and Atmospheric Administration (NOAA) 404-MHz profilers. The NOAA sites also include a set of surface instrumentation comparable to the SMOS suite, and these data will accompany the profiler data. The schedule for installation of RASSes (radio acoustic sounding systems) on the NOAA profilers is uncertain. Initially, the boundary facilities will be minimal, a temporary arrangement sufficient to support the SCM IOPs. The definition of requirements for permanent, turn-key facilities is nearing completion, and the full facilities could be in place by August 1994 if the site operations budget is sufficient to support routine operations at the boundary facilities. Otherwise, full development will be deferred until the next fiscal year.

Figure 2 summarizes site development activities. Milestones and complex tasks are distinguished from simple tasks or activities.

4.2.2 Instruments

The current status of and plans for instrument acquisition and deployment are summarized in Tables 8-10. During this six-month period, the central facility should gain the final components of the solar and infrared radiation observing station (SIROS) (shadow arms and the shaded pyranometer), the Heimann infrared thermometer, the all-weather cavity pyrheliometer, two multifilter radiometers, the EC sensors (both on the tower and near the surface), and some subset of the aerosol and calibration instrumentation, as indicated in Figure 3. Ozone sondes were originally included in the list of instruments planned for the SGP site, in anticipation of a need to correct radiation flux divergence measurements on the basis of vertical ozone profiles. A recent analysis of SPECTRE data indicated that the error in flux divergence (with and without ozone profiles) was less than 2%, a figure smaller than the model calculation errors. This result suggests that the requirement for ozone profiles should be re-examined, especially because the costs associated with regular ozone sonde releases could quickly rival those of the BBSSes. The installation cost is moderate ($20,000), but the individual ozone sondes are expensive ($700 per sonde) and manpower needs are intensive. A newly identified potential need for ozone profiles concerns the overlap of the ozone and water vapor absorption bands in the 1150-wavenumber region of the AERI data, which may require ozone profiles for analysis. This question is being evaluated by the Science Team and the EST.

Of the nine extended facilities, the two with incomplete SIROS systems will be finished, and the other six permanent sites will receive complete SIROS systems and the two missing SMOSes. If sufficient funds are available, six other facilities will be initiated and equipped as more SIROS, SMOS, EBBR, and EC systems become available.

When the turn-key boundary facilities have been completed (with BBSS and MWR permanently installed) and the AERI engineering problems have been resolved, an AERI will be available for use at the Vici boundary facility as well, but installation at Vici might be delayed until a way to operate without liquid nitrogen can be developed.

When all of these instruments are in place (as summarized in Tables 6 and 7), the first phase of instrumentation at the central and boundary facilities will be complete, leaving only the extended facilities to be completed.

TABLE 6 Observational Instruments and Systems in Place at Central and Boundary Facilities by June 30, 1994

Central Facility

Radiometric Observations

- AERI
- SIROS
  - Pyranometer (ventilated)
  - Pyranometer (shaded, ventilated)[a]
  - Pyrgeometer (shaded#, ventilated)
  - NIP on tracker
  - MFRSR
- Pyranometer (upwelling, at 10 m)
- Pyrgeometer (upwelling, at 10 m)
- Pyranometer (upwelling, above wheat at 25 m on 60-m tower)
- Pyrgeometer (upwelling, above wheat at 25 m on 60-m tower)
- Multifilter radiometer (upwelling, at 10 m)
- Multifilter radiometer (upwelling, above wheat at 25 m on 60-m tower)
- All-weather cavity pyrheliometer[a]

Wind, Temperature, and Humidity Sounding Systems

- BBSS
- 915-MHz profiler with RASS
- 50-MHz profiler with RASS
- MWR
- Heimann infrared thermometer[a]

Cloud Observations

- Interim whole-sky imager
- Belfort laser (interim) ceilometer
- Micropulse lidar (IDP) ceilometer

Instruments and Systems in the Aerosol Trailer

- Optical absorption system[a]
- Integrating nephelometer (1-lambda)[a]
- Optical particle counter[a]
- Condensation particle counter[a]
- Ozone monitor[a]
- Manifold sample system[a]

Instruments and Systems in the Calibration Trailer

- Solar spectroradiometer[a]
- Site reference cavity radiometer[a]
- NIST (National Institute of Standards and Technology) standard lamps with controlled current source[a]
- Reference blackbody[a]
- Optical breadboard system[a]

Others

- SMOS
- EBBR
- Temperature and humidity probes at 60 m on tower
- Eddy correlation systems near surface[a]
- Eddy correlation systems on 60-m tower[a]

TABLE 6 (Cont.)

Boundary Facilities

Permanent installations ([a]) are in place at Hillsboro, Kansas; Vici, Oklahoma; and Morris, Oklahoma. Each includes a BBSS and a MWR.

Auxiliary Facilities

None in preparation

[a] Added after January 1, 1994.

TABLE 7 Observational Instruments and Systems in Place at Extended Facilities, Apart from the Central Facility, by June 30, 1994[a]

Location	SMOS	SIROS	EBBR	EC	Data Intake
Kansas					
Ashton	X	X	X	-	Coded switch
Coldwater	X	X	X	-	Coded switch
Plevna	X	X	X	-	Coded switch
Elk Falls	X	X	X	-	Coded switch
Tyro	-	X	-	X	Coded switch
Towanda	X	X	-	X	Coded switch
Larned	X	X	-	X	Coded switch
LeRoy	*	*	-	*	*
Hesston	*	*	-	*	*
Hillsboro	-	X	X	-	Coded switch
Oklahoma					
Ringwood	X	X	X	-	Coded switch
Okmulgee	*	*	-	*	*
Meeker	X	X	X	-	Coded switch
Cordell	-	X	X	-	Coded switch
El Reno	-	*	*	-	*
Pawhuska	-	X	X	-	Coded switch
Vici	-	X	-	X	Coded switch
Morris	-	X	X	-	Coded switch
Ft. Cobb	-	*	-	*	*
Cyril	X	X	-	X	Coded switch
Byron	X	X	-	X	Coded switch
Cement[b]	-	-	X	-	Modem

[a] X means installed, * means planned for installation, - means no installation currently planned, "diskette" means data are retrieved manually on diskette, "modem" means data are retrieved remotely by telephone, "coded switch" means data are retrieved automatically by computer through coded switches. All sites will eventually transfer data by coded switches to the central facility. Eight of the sites are co-located with either an Oklahoma Mesonet or an NWS site, so that a SMOS would be redundant and is not planned. Each site will have either an EBBR (over pasture) or an EC (over cropland) system.

[b] Temporary facility to support the 1994 GEWEX study.

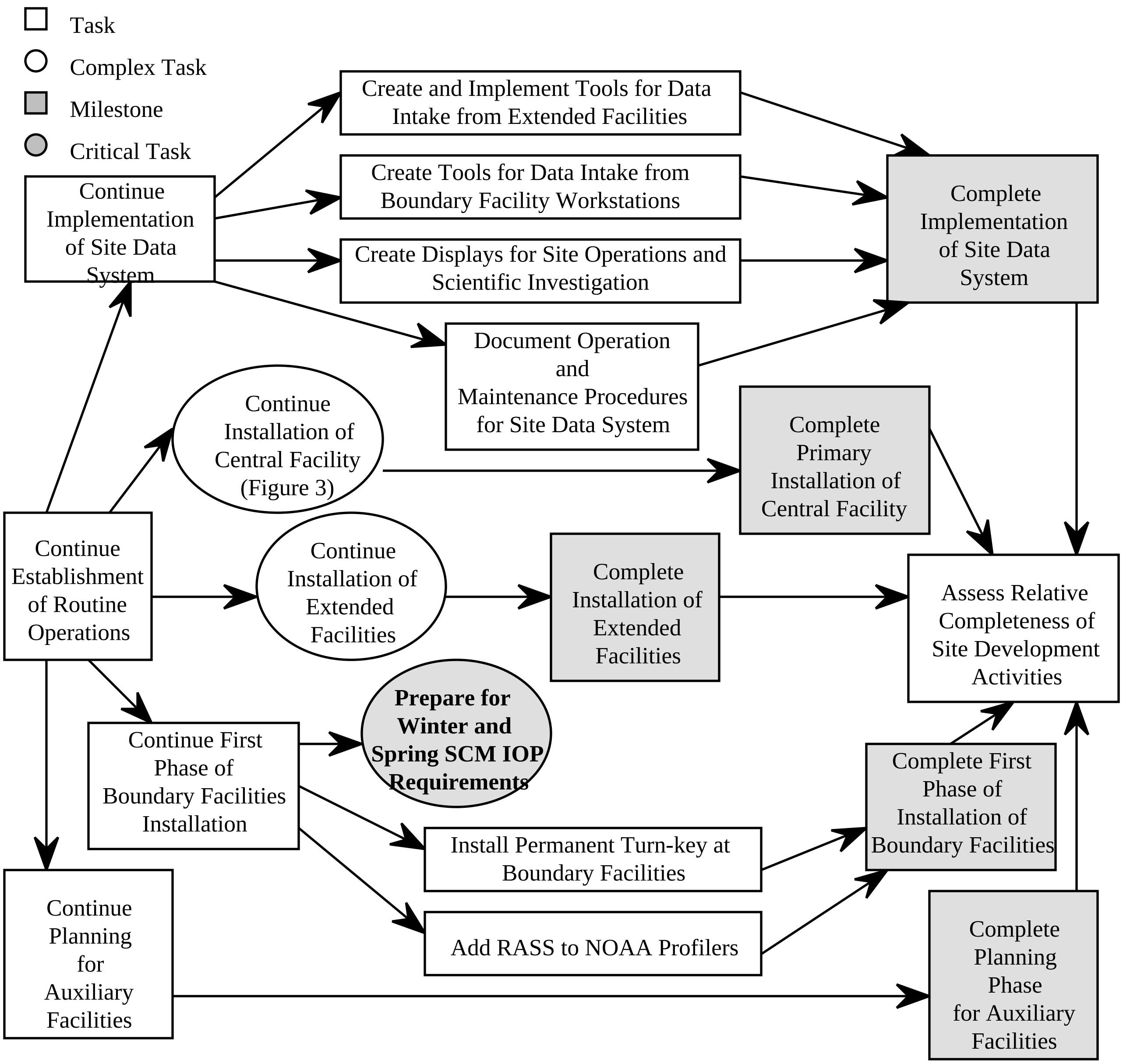

FIGURE 2 Site Development Activities to Establish Routine Operations

TABLE 8 Status of Instrument Acquisition and Deployment on December 31, 1993

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
WSI	Thorne	5/93	2/94	Loaner in 10/20/93	—	—	Loaner data analysis to be done off site
MWR	Liljegren	Done	5/93	Done	—	Two units in 12/93; one in 1/94	Replace central facility unit with new unit in 11/93
IR thermo-meter	Liljegren	Done	At PNL[a] now	11/93	—	Two units in 12/93; one in 1/94	For use with the MWR
BBSS	Lesht	Done	Done (5/93)	Done	—	Three units in 12/93	Interference by 404-MHz profiler being investigated
EBBR	Cook	Done	Ten units; two more Winter 1993	Done	Nine units installed	—	—
PAM-II	Tomich	Done	Done	Removed 3/29/93	Removed 3/29/93	—	Quality control on data needed
915-MHz RASS	Coulter	Done	Done	Done	—	—	Transfer site data intake to production system in 11/93
50-MHz RASS	Coulter	Done	10/93	11/93	—	—	—
SMOS	Hart	Done	First ten in 3/93	Done	Four in 4/93, five in Winter 1993	—	Five units stored at CF; five more to be ordered 1/93

TABLE 8 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
Belfort laser ceilometer	Griffin	Done	3/93	11/93	—	—	Visual checks are OK
Calibration facility	Hultstom	In process	Spring 1994	Design review 11/93	—	—	—
60-m tower	Cook	Done	Done	Done	—	—	Relative humidity sensor problems resolved 11/93
Eddy correlation	Hart, Cook	Done	1/93	Spring 1994	Spring 1994	—	Testing at Argonne in winter 1993
Aerosols							
CCN counter	Leifer	Cancelled	—	—	—	—	—
Manifold sample system	Leifer	Design in progress	—	Design review, Winter 1993?	—	—	—
Ozone monitor	Leifer	Done	At EML[b]	Done	—	—	—
Collection system	Leifer	Cancelled	—	—	—	—	—
Optical Absorption System (AOAS)	Leifer	Technical reviews done	Fall 1993	—	—	—	—
3-l integrating nephelo-meter	Leifer	Specifi-cations being written	??	??	—	—	Three-wavelength unit not yet available from vendors

TABLE 8 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
1-l integrating nephelo-meter	Leifer	Done	At EML	??	—	—	—
Optical particle counter	Leifer	Done	At EML	??	—	—	—
Conden-sation particle counter	Leifer	Done	At EML	??	—	—	—
Broadband radiometers - SIROS							
MFRSR	Berndt	Done	Partial	Revision 7, 11/93	Two units in 10/93	—	Fifteen units being updated, ten more later
Broadband radiometer loaners	DeLuisi	Done	Done	Done; removed 12/93	—	—	QME to be done to compare Broadband Solar Radiation Network with SIROS
Pyrano-meter (ventilated)	DeLuisi	Partial	Partial	SIROS, 10/93	Two SIROSes, 10/93	—	Installations partial in 10/93
Pyrano-meter (upwelling 10 m)	DeLuisi	Done	Fall 1993	SIROS, 12/93	2 SIROSes, 12/93	—	—
Shaded pyrano-meter (ventilated)	DeLuisi	??	??	Needs new shading disk assembly	Needs new shading disk assembly	—	—

TABLE 8 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
Pyrgeo-meter (shaded and ventilated)	DeLuisi	??	??	Needs new shading disk assembly	Needs new shading disk assembly	—	—
Pyrgeo-meter (upwelling 10 m)	DeLuisi	Done	Fall 1993	SIROS, 12/93	Two SIROSes, 12/93	—	—
Pyrhelio-meters (NIP)	DeLuisi	Partial	Partial	SIROS, 10/93	Two SIROSes, 10/93	—	—
Trackers for NIP	DeLuisi	Partial	Partial	Loaners from ARL[c] initially	Loaners from ARL initially	—	—
Other Radiometric Instruments							
All-weather cavity pyrhelio-meter	DeLuisi	Done	Done	Winter 1993	—	—	—
Pyrano-meter for 60-m tower	DeLuisi	Done	Done	12/93	—	—	—
Pyrgeo-meter for 60-m tower	DeLuisi	Done	Done	12/93	—	—	—
Solar spectral radiometer	DeLuisi	Specifi-cations being written	??	??	—	—	—

TABLE 8 (Cont.)

Instrument	Mentor	Ordered	Delivered	Central Facility Installation/ Acceptance	Extended Facility Installation/ Acceptance	Boundary Facility Installation/ Acceptance	Comment
AERI	Griffin	Done	Fall 1993; testing in progress	??	—	—	Initial intake through Experiment Center
Special IR broadband radiometer	—	—	Unknown - unmet measure- ment	—	—	—	—
Multifilter radiometer for upwelling at 10 m and 25 m	Berndt	Done	12/93	12/93	—	—	—

[a] PNL, Pacific Northwest Laboratory.
[b] EML, Environmental Measurements Laboratory.
[c] ARL, Air Resources Laboratory.

TABLE 9 Status of Radiometric Calibration Facility on December 31, 1993

Component	Mentor	Procurement Status	Delivery	Site Installation/ Acceptance	Comments
Calibration trailer	—	Done	Done	Installed	Not equipped
Solar spectroradiometer	Cannon	Done	Delivered to NREL[a]	Spring 1994	Problems recently resolved
Site reference cavity radiometer	Wells	Done	Delivered to NREL	Spring 1994	NREL calibration checks, fall 1993
Program reference cavity radiometer	Wells	Done	Delivered to NREL	Spring 1994	NREL calibration checks, fall 1993
Reference sunphotometer	Wells	Specifications not completed; order spring 1994	—	Summer 1994	—
Automatic trackers	Wells	Specifications not completed; order winter 1993	—	Spring 1994	—
Large automatic tracker	Wells	Specifications not completed; status unknown	—	Spring 1994	Needed immediately?
Reference diffuse system	Wells	Specifications not completed; order winter 1993	—	Spring 1994	—
Working standard pyrgeometers	Wells	Specifications not completed; status unknown	—	Spring 1994	Needed?
Optical breadboard system	Wells	Specifications nearly completed	Winter 1993	Spring 1994	—
NIST standard lamps	Wells	Specifications completed, order fall 1993	—	Spring 1994	—

TABLE 9 (Cont.)

Component	Mentor	Procurement Status	Delivery	Site Installation/ Acceptance	Comments
Controlled current source for lamps	Wells	Specifications being written; order Fall 1994	—	Spring 1994	—
Reference blackbody	Wells	Specifications not completed; order Fall 1994	—	Spring 1994	Eppley standard blackbody

[a] NREL, National Renewable Energy Laboratory.

TABLE 10 Future Instruments[a]

Future Instruments (IDP)	IDP Investigator/ Mentor	Procurement	IDP Testing
UV spectral radiometer	Harrison/ ??	No	Winter1993?
Rotating shadowband spectrometer	Michalsky and Harrison/ ??	No	Spring 1994?
Shortwave narrowband radiometer	Kryter	Currently removed from consideration	None
SORTI	MurCray/ ??	No	11/93
Net radiometric profiler	Whiteman/ ??	No	Not scheduled yet
Cloud lidar	Goldsmith/ Griffin	Specifications being prepared	Not scheduled yet
Cloud radar	Widener (directed deviation)	Specifications being prepared	Not scheduled yet
Microwave water vapor profiler	McIntosh and Westwater/ ?	No new IDP project	—

[a] Includes IDP instruments.

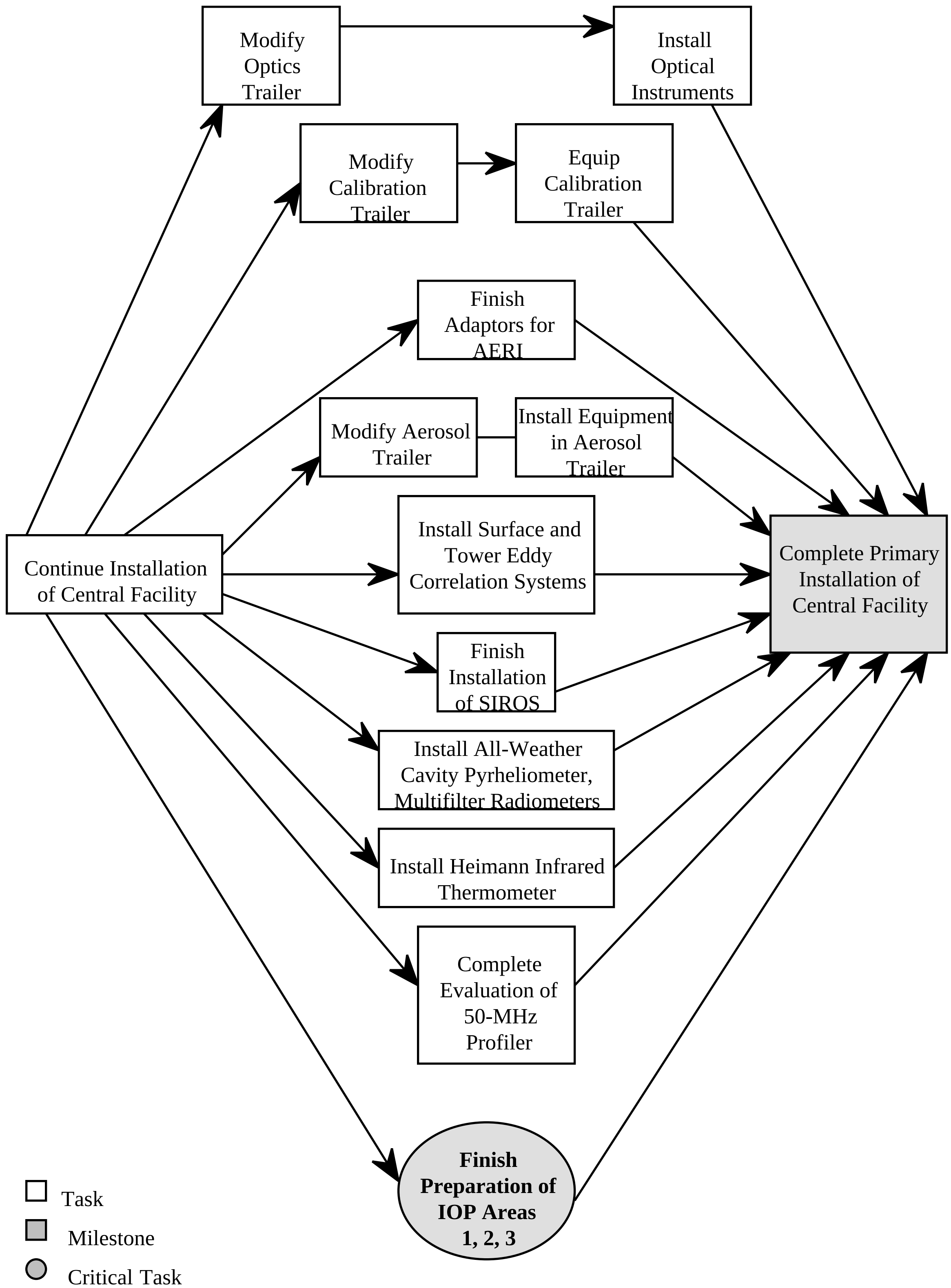

FIGURE 3 Site Development Activities to Install Central Facility

4.2.3 Data Intake Modules for the Site Data System

Several of the installed instruments and all of the new instruments will require creation of software to transfer the data from the instrument platforms to the SDS. Transfer of data by coded switches from the extended facilities and from the workstations at the boundary facilities will also be required.

4.2.4 Measurements and External Data

The Experiment Center will continue to prepare software to produce measurements from the available observations. The status of the measurements near the beginning of this six-month period is summarized in Table 4.

4.2.5 Limiting Factors

The most basic of limiting factors is the resources available for continuing site development, expanding operations, and providing necessary support for the Instrument Team (IT), the Data Management Team (DMT), and the EST. Shortfalls result in delays in implementation. Other significant limiting factors are the time lags inherent in the procurement process and the preinstallation calibration of radiometers.

Site operations staff have begun to require all systems awaiting construction or installation to go through a formal design review of structural and mechanical systems. For example, the aerosol intake stack for the aerosol trailer and the calibration platform deck for the calibration have undergone such review. These reviews frequently identify deficiencies in plans and drawings related to engineering requirements, procurement details, and quality control. This activity was recently expanded to include large or complex IOPs like the Cloud Remote Sensing IOP, in an effort to integrate the staggering variety of IDP instrument support requirements for cost-effective implementation. Construction or installation will not begin until the design review process has been successfully completed. And as mentioned in Section 4.2.1, the IDP pads must be completed before they can be used for the Cloud Remote Sensing IOP.

The costs associated with BBSS launches (including both expendables and manpower) will be a burden on the operations budget until they are replaced by continuous, unmanned remote-sensing systems. These expenses are a strong constraint on the total number and frequency of launches, making it impossible to routinely provide all of the requested launches (eight per day at the central and boundary facilities) defined as the optimal sounding strategy for SCM requirements by the EST ("Three Strategies for Soundings at the SGP CART Site" by Bradley and Cederwall). The intermediate sounding strategy is probably within reach of the operations budget and is our target for this six-month period. However, in direct conflict with BBSS launch schedules at the central facility is the optimal sounding strategy for IRF requirements of the EST ("ARM IRF Temperature and Water Vapor Profiling Strategies" by Liljegren). A proposed site operations schedule that meets elements of both measurement strategies is outlined in Section 4.2.6.

Routine observations at boundary facilities cannot begin until the interim facilities are completed and data intake procedures are in place. And as mentioned earlier, remote sensing of virtual temperature profiles at the boundary facilities will probably not occur during this six-month period, because NOAA is still testing and evaluating the RASSes under consideration for its 404-MHz profilers.

4.2.6 Schedule

Changes in the schedule for site operations are driven primarily by the need to launch rawinsondes. Site operations staff and the EST have reached a compromise on the sonde launch schedule that becomes the target goal for these six months. The EST intermediate sounding strategy proposes that four rawinsondes be released simultaneously, Monday through Friday, at the central facility and each of the three boundary facilities. This routine schedule would be supplemented by four seasonal SCM IOPs annually, each lasting 21 consecutive days with eight rawinsonde launches per day. Current budget projections suggest that we can support a version of this activity, with the real limitation being the expense of staffing the launches. Our plan (Table 11) is to employ staggered shifts and a different launch schedule at the central facility, and to conduct launches routinely only five days per week, to minimize these costs for the rest of this fiscal year.

At the end of the January IOP, boundary facility rawinsonde activities will cease until permanent staff can be hired and trained for all of the boundary facilities, we hope by March 1994. Two full-time staff members will be hired for first- and second-shift work for each of the boundary facilities, and six full-time staff members will be hired for the central facility for staggered shift work, to handle the increased burden of site operations activities (including more extended facilities).

Table 11 Rawinsonde Launch Schedule[a]

Central Facility		Boundary Facilities	
Time (LST)	Time (UTC)	Time (LST)	Time (UTC)
Routine Operations (4 per day, 5 days days per week including holidays)			
0600	1200	0600	1200
0730-1200[b]	1330-1800	1200	1800
1400	2000	1800	0000
1800	0000	0000	0600
SCM IOP Operations (8 per day, 7 days per week including holidays)			
0300	0900	0300	0900
0600	1200	0600	1200
0900	1500	0900	1500
1200	1800	1200	1800
1500	2100	1500	2100

[a] Launch time is 30 min earlier; the stated time represents the approximate midpoint of the flight.

[b] Morning float.

The establishment of a 24-hr per day, seven-day workweek at all facilities will be deferred until the resources are available.

4.3 Routine Operations by June 30, 1994

4.3.1 Observational Instruments and Systems

The projected suite of instruments installed by June 30, 1994, is summarized in Tables 6 and 7.

4.3.2 Launch Schedule for BBSSes

The target schedule for BBSS launches will be as indicated in Table 11 with routine operations consisting of four rawinsonde launches per day. In addition, SCM IOPs with eight rawinsonde launches per day are planned for January and April.

5 INTENSIVE OPERATIONS

The base of the ARM CART program is a suite of continuous observations, but a number of critical observations are either too expensive to be produced continuously at the desired frequency or require instrumentation that cannot be continuously deployed. In addition, some questions concerning data accuracy or representativeness (for either established instruments or prototypes) can be answered only with periods of more frequent observations. Acquiring these observations will require special efforts and arrangements by the SGP site staff; such events are categorized as IOPs, because they frequently include activities beyond the routine observations. The IOPs can be in support of the needs of the Science Team, QMEs, IDPs, campaigns, and even field tests of non-CART instruments. Table 12 lists IOPs that have occurred, are occurring, or are in the design stage.

The initial design of most special operations will be in the hands of the EST. Prototype procedures to facilitate the design, review, and implementation process are outlined in a planning document for IOPs by Dickerson and Cederwall. Similar documents are being prepared by the Campaign Team leader to facilitate interagency collaborations and by the Operations Team leader to facilitate use of guest instruments. The SST will assist the EST in the generation of plans for special operations; will include the plans for approved QMEs, IOPs, and campaigns in the *Site Scientific Mission Plan*; and will assist in the execution of special operations. With the many-month lead time necessary to schedule research aircraft, it is important that design of special operations involving aircraft begin more than one year before the projected operation and be sufficiently complete to be included in collaborative proposals.

Except for the *Winter SCM IOP Implementation Plan* (Appendix A) and the *Spring Integrated IOP Implementation Plan* (Appendix B), the descriptions of special operations presented here are sketchy because of the immaturity of the respective planning efforts. A substantial effort will be required to bring the plans for this host of proposed IOPs to a state suitable for execution, and planning must begin much further in advance than it has so far. The lack of a solid plan for the April Cloud Remote Sensing IOP this close to the proposed field date endangers our ability to support this activity. Thus, the information presented here, which summarizes the knowledge currently in hand on all special operations, should generate interprogram attention and discussion, especially for activities scheduled to occur in this six-month period.

TABLE 12 Intensive Observation Periods

Date	Name	Science Team Member[a]	EST Contact	Description	Status
11/92	Field Test of NCAR Flux Profiler	D. Parsons (NCAR)	R. Cederwall	Enhanced soundings at the central facility and profiler site were made 11/10-11/19; boundary layer flights were also conducted on a few days.	Completed; data available summer 1993.
4/93	AERI Field Test	H. Revercomb (UW)	J. Liljegren	Enhanced soundings at the central facility were requested during the field acceptance test of the AERI instrument.	Completed 4/29/93.
5/93-6/93	Using the Global Positioning System (GPS) for the Measurement of Atmospheric Water Vapor	Collaborative (UNAVCO and NCSU)	J. Liljegren	The purpose was to test the investigators' technique for infering total precipitable water vapor in the atmosphere column by using GPS signals.	Completed 6/8/93; reduced data were to be sent to ARM in fall 1993. ARM MWR and BBSS data delivered 7/2/93; SMOS data delivery awaiting mentor approval.
6/93	Warm Season Data Assimilation and Integrated Sounding System (ISS) Test	D. Parsons (NCAR)	R. Cederwall	This was an enhanced sampling (in time and space) of the SGP domain for a 10-day period with profilers and sondes. The primary goals of the IOP were (1) to study the performance of four-dimensional data assimilation (FDDA) under thermodynamic conditions typical of the continental warm season and (2) to evaluate the estimates of divergence and vorticity from the prototype NCAR ISS with interferometric techniques, the triangle of three 915-MHz profilers, and the results of FDDA.	Completed; ran for 10 days (6/16-6/25); data were to be available in late summer or early fall 1993.

TABLE 12 (Cont.)

Date	Name	Science Team Member[a]	EST Contact	Description	Status
Not set	Simultaneous Ground-Based, Airborne, and Satellite-Borne Microwave Radiometric and *In Situ* Observations of Cloud Optical Properties and Surface Emissivities	W. Wiscombe (NASA-GSFC); E. Westwater (NOAA-WPL)	J. Liljegren	Observations of cloud optical properties will be obtained over the CART site simultaneously from ground-based, *in situ*, and satellite-borne sensors; spatial variability of surface emmissivities will be assessed in order to attempt retrieval of total precipitable water and cloud liquid water from the special sensor microwave imager.	Proposal distributed (to IRF); initial planning discussions between Wiscombe and L. Fedor at NOAA; postponed.
1/94 4/94 7/94 10/94	Seasonal SCM IOP	D. Randall (CSU)	M. Bradley	Seasonal IOP with enhanced frequency of observations, particularly vertical soundings of temperature, water vapor, and winds at central facility and boundary facilities for periods of 21 days; the required sounding frequency is 8/day. The data are required for quantifying boundary forcing and column response. Enhanced radiative transfer measurements will likely be required.	Discussion in progress, experiment design to be completed by end of July, first IOP planned for winter 1994, depending on observation availability.
4/94-5/94	Remote Cloud Sensing IOP	R. McIntosh (UM); B. Kropfli (NOAA); T. Ackerman (PSU); K. Sassen (UU); A. Heymsfield (NCAR); and others	M. Bradley; J. Griffin (IDP contact)	The primary purpose is the field evaluation and calibration of several remote-sensing, cloud-observing instruments (some of which are from the IDP project). *In situ* cloud observations are critical to the success of this IOP. Enhanced soundings will also be required at the central facility.	Discussion in progress; proposal in preparation; planned for spring 1994; preliminary planning meeting held in Breckenridge, Colorado, on 6/14/93; planning meeting scheduled for 1/13/94.

TABLE 12 (Cont.)

Date	Name	Science Team Member[a]	EST Contact	Description	Status
4/94	Feasibility Tests of ARM Unmanned Aerospace Vehicle (UAV)	J. Vitko (SNL); G. Stokes (PNL)	J. Liljegren	Measurements of clear-sky flux profiles acquired by a UAV and surface support data, to be used to understand clear-sky heating rates and the ability of models to reproduce the observations.	Planned for February 1994 at SGP CART site; successful engineering test flights held in November 1993 at El Mirage.

[a] Affiliations: CSU, Colorado State University; GSFC, Goddard Space Flight Center; NASA, National Aeronautics and Space Administration; NCAR, National Center for Atmospheric Research; NCSU, North Carolina State University; NOAA, National Oceanic and Atmospheric Administration; PNL, Pacific Northwest Laboratory; PSU, Pennsylvania State University; SNL, Sandia National Laboratory; UM, University of Massachussetts; UNAVCO, University NAVSTAR Consortium; UU, University of Utah; UW, University of Wisconsin; WPL, Wave Propagation Laboratory.

5.1 Quality Measurement Experiments

As part of the data quality assurance effort, our focus needs to go far beyond the simple calibration of instruments, to intercomparison of data streams and to evaluations of our ability to capture an accurate representation of the state of the atmosphere. The QMEs are experiments that address these problems and are designed and managed in a manner analogous to the experimental designs of the Science Team members. While QMEs can be proposed by anyone within the ARM Program, they constitute a special joint responsibility for the EST and the SST. Not all QMEs require IOPs or increased data taking. The following is an example:

QME Name:	Comparison of MWR and Sonde Water Vapor Profiles
Science Team Member: (STM Contact)	E. Westwater
EST Contact:	J. Liljegren/N. Miller
Status:	Ongoing; executed automatically at the Experiment Center
Brief Description:	The purpose of the QME is twofold: (1) Use soundings from the BBSS to drive a radiation transfer model (from Atmospheric and Environmental Research, Inc. [AER]) and compute the microwave brightness temperatures that the MWR should see, then compare the calculated values to the actual brightness temperatures observed by the MWR. (The relationship between the computed and observed values is the "tuning function" needed to account for shortcomings in the model. The retrieval coefficients supplied by AER and used by the MWR for deriving the precipitable vapor and liquid water path from the brightness temperatures were based on this model. Thus, to use the retrievals coefficients requires a transformation from actual space to model space). (2) Compare the precipitable vapor computed along the sonde trajectory with the equivalent quantity derived from the averaged MWR brightness temperatures by using the AER-supplied retrieval coefficients.

The QMEs that are either in preparation or under consideration include the following:

- Comparison of spectral radiances observed by the AERI and computed by the line-by-line radiative transfer model (LBLRTM). This QME analyzes the residual differences and uses temperature and moisture profiles from the central facility as input. The goal is to improve the modeling of the surface spectral radiances.

- Comparison of cloud base observation data derived from the Scripps whole-sky imager, the Belfort ceilometer, the Spinhirne micropulse lidar ceilometer, and any cloud radars deployed at the central facility for IOPs. This QME is under consideration; we are awaiting installations and IOPs including cloud radars.

- Comparison of broadband radiative surface fluxes, both between instruments measuring the same quantity and calculated from combinations of observations. This effort is currently in draft form and will be developed further and executed when the new SIROS is installed at the central facility (in preparation).

- Comparison of thermodynamic profiles derived from the BBSS and the RASS profilers, with near-surface values from the SMOS and the 60-m tower instruments. This QME is under consideration; we are awaiting installation of the 50-MHz profiler.

- Comparison of wind profiles derived from the BBSS and the profilers. This QME is under consideration; we are awaiting installation of the 50-MHz profiler.

- Comparison of the fluxes derived from the EBBR and EC systems. This QME is under consideration; we are awaiting installation of the EC system at the central facility.

The results of these and other QMEs will have both short- and long-term effects on the ARM data stream and on site management, including advisories to the Science Team concerning data quality, modifications in data acquisition strategies, and reassessments of measurement algorithms. The most important and unique of the instrument comparisons will be distributed as internal ARM reports and submitted for publication in appropriate journals.

5.2 Supplement to Continuous Observations

Six of the IOPs listed in Table 12 are primarily for the purpose of testing instrument systems intended for possible ARM deployment, but four of these IOPs will also produce supplemental data of use to the Science Team at large (the Field Test of NCAR Flux Profiler, the Warm Season Data Assimilation and Integrated Sounding System Test, the Remote Cloud Sensing IOP, and the Feasibility Tests of the ARM UAV). The other two IOPs listed in Table 12 will specifically address unfilled observational needs of the SCM and DA groups: the Wiscombe-Westwater cloud observations and the Seasonal SCM IOP. The Wiscombe-Westwater cloud observations have been postponed until appropriate aircraft support can be arranged. The Seasonal SCM IOP will begin in January and continue in April. The only critical dependency in site development for the Seasonal SCM IOPs is the completion of the first three boundary facilities in at least a minimal status.

Because of budget concerns, site operations staff are taking a conservative approach to the implementation and staffing of the three boundary facilities for the January SCM IOP. The minimum staff required to operate a boundary facility for three shifts (24-hr operation) is four: one per shift on a rotating schedule. The minimum additional personnel requirement for second- and third-shift work at the central facility is five, if current staff are used in an overtime mode for the first shift on weekends. The required 17 personnel for the January SCM IOP will be temporary hires, who will require three days of training before they man the boundary facilities for 21 consecutive days of operations.

Early plans to support the Feasibility Tests of the ARM UAV in February suggest that the effect on site operations will be much smaller than that of the January SCM IOP. Requirements include forecast support, rawinsonde launches every 2 hr during flights, site support for a suite of guest radiometers, and noninterference by other instrument launches. This support should be fairly straightforward if the January SCM IOP is finished before the UAV IOP begins in late February.

A major planning meeting for the Remote Cloud Sensing IOP will occur in January. Questions about the utility of co-scheduling this IOP and the April SCM IOP need to be addressed, as well as the potential problems and benefits of the VORTEX (Verification of the Origins of Rotation in Tornadoes Experiment) campaign, scheduled for the same area from April through June (see Section 5.3).

5.3 Support for the Instrument Development Programs, Guest Instruments, and Campaigns

The SGP CART site is an ideal location for rigorous field tests of new observational systems and has been designed to support these activities with a minimum of disruption to the continuous observations. Six of the IOPs in Table 12 were designed to support various instrument development activities. The field tests of the NCAR flux profiler (November 1992 and June 1993) are continuing efforts in the development of an instrument that will remotely and continuously measure near-surface momentum and virtual temperature fluxes. The AERI (April 1993) should be capable of routine detection of infrared radiances with high spectral resolution and accuracy and will be essential to experiments on the effects of greenhouse gases, clouds, and fine particles on atmospheric transmission, absorption, and emission. More AERIs are scheduled for later deployment at the SGP boundary facilities, where they will be used to infer vertical profiles of temperature and humidity below the cloud base. The global positioning system (GPS) is an example of use of a problem (noise in the data stream of the system) in an attempt to produce a continuous, low-cost measurement (total water vapor in the intervening atmosphere, and possibly profiles of water vapor) that would be of value to the ARM Program. The GPS effort was not funded by ARM, but it was hosted by the site as a guest instrument. The SGP CART site will also be a logistically friendly base for early tests of the ARM Unmanned Aerospace Vehicle (UAV) Program (April 1994), a platform that figures prominently in plans for future oceanic CART sites. The ARM UAV program is a self-standing sister program of ARM CART. The ARM UAV effort is a campaign that will occur simultaneously with the Spring SCM and Remote Cloud Sensing IOPs. The Remote Cloud Sensing IOP (April-May 1994) will be a critical step toward building a capability to remotely and continuously observe both cloud distribution and microstructure, which are currently unfilled SGP observational needs.

5.4 Campaign Planning

Table 13 summarizes potential campaigns and cooperative projects that have been called to our attention. Plans for these activities are in various stages of development, and the topics are briefly listed here to generate further discussion. Inclusion in this list does not imply any endorsement of these activities by the ARM Program, except for the GVaP (GEWEX Water Vapor Project) as the Department of Energy's contribution to GEWEX.

Except for some special hydrologic measurements, the GEWEX/GCIP/GIST (GEWEX Integrated System Test) observations will be limited to currently operational observation networks and the SGP data. The GIST participants have expressed a strong interest in co-scheduling their field work with our spring (nominally April) SCM IOP.

The VORTEX field program will be sending teams of special observers across Texas, Oklahoma, and Kansas from April through June, chasing mesoscale convective complexes and tornadic storms. Their teams will include mobile laboratories launching rawinsondes (in the same frequency band as the SGP BBSSes) and the NOAA WP-3D instrumented aircraft. The

VORTEX principal investigators will be proposing a collaborative effort with ARM in the near future, emphasizing plans to avoid interference, exchange data, engage in limited joint activities in 1994. These investigators will also participate in planning and aircraft proposals for 1995.

TABLE 13 Collaborative Campaigns and Activities under Discussion

Title	Proponent/Contact[a]	Projected Date
Flux Divergence	J. Vitko	Spring 1994
Ultraviolet-B Intercomparison	A. Thompson (NIST, DOA)	Spring 1994
GEWEX GVaP	H. Melfi	?
Water Vapor Profile Intercomparison		Spring 1995
GEWEX ISLSCP/GCIP[b]	P. Sellers	
Integrated GEWEX System Test (GIST)		Spring 1994
Land Surface Studies		?
GEWEX Cloud System Study (GCSS)	M. Moncrieff	?
Cooperative Multiscale Experiment	W. Cotton (CSU)	Spring, summer 1995
Boundary Layer Facility	W. Blumen (CU)	?
Gulf Moisture	W. Pennell	?
Tornado Field Experiment (VORTEX)	E. Rasmussen (NSSL)	Spring 1994, 1995
Project Halo: Annular Solar Eclipse Observations	G. Stokes	May 10, 1994

[a] Affiliations: CSU, Colorado State University; CU, Colorado University; DOA, Department of Agriculture; NIST, National Institute of Standards and Technology; NSSL, National Severe Storms Laboratory.

[b] ISLSCP/GCIP, International Satellite Land-Surface Climatology Project/GEWEX Continental-Scale International Project.

6 LOOKING AHEAD

The site development effort has been intense, the progress significant. By the end of June 1994, the central and boundary facilities should be nearly complete, with an effort to complete nine extended facilities and install some set of instrumentation at six more. The establishment of routine operations will cease to be a priority activity once all facilities are complete. A better characterized stream of observations should be arriving at the Experiment Center by the end of June, and most of the highest priority measurements should be flowing to the Science Team. The focus of the *Site Scientific Mission Plan* will shift to the major and ongoing business of analyzing the quality of the measurements being delivered to the Science Team and their utility in fulfilling research needs and the overall goals and objectives of the ARM Program. The EST and SST will be actively involved in planning and implementation of IOPs designed to provide supplemental SGP CART observations, with an eye to adaptations needed to meet unfilled or newly realized observational needs. The top scientific priority for site activities will then become implementation of QMEs, followed by planning and support of IOPs, with the IOPs supporting Science Team and IDP measurement requirements rated slightly higher than campaign support.

We expect the scientific focus to shift in the coming years as the SGP data are employed and analyzed by the Science Team. As a result of the IOPs currently in planning, the first full round of experiment operations plans (EOPs, the detailed specifications of measurements for each scientist) will be filled in late 1993 and early 1994. Even while IOP data are being investigated in 1994, there will be strong demand for further IOPs to capture yet-to-be-observed phenomena, especially relative to cloud structure and composition and the radiative state of the atmosphere in the vicinity of clouds. By early 1995, the collective experience of the Science Team should be redirecting both model development and priorities for field observations. Since the heart of the problem is the parameterization of physical processes, it is highly probable that a handful of studies will emerge as most critical for further progress. The challenge will be to monitor and facilitate the development of consensus on priorities for site activities and then to develop and execute effective and cost-efficient plans for operations.

Appendix A

ARM PROGRAM
SOUTHERN GREAT PLAINS
CLOUDS AND RADIATION TESTBED SITE

SITE OPERATIONS

WINTER SCM IOP

IMPLEMENTATION PLAN

Final

November 30, 1993

Prepared by: J. Teske
Site Operations Manager

1 INTRODUCTION

A major SGP CART Program milestone is currently scheduled to occur in January 1994. This milestone is the conduct of the first ARM Seasonal SCM IOP which is discussed in the EST SCM IOP Plan. Schedules indicate that the IOP will consist of a 21 day period, and will require 24 hour per day, 7 days per week operations personnel support from the Central Facility and three Boundary Facilities. Rawinsonde launches are planned for once every three hours from all four sites during the IOP, as well as ensuring that all other CART site instruments are at optimal performance during the exerciseperiod.

In order to achieve this significant program milestone, substantial planning is required, and the time remaining to implement the necessary IOP operations support is limited. This document provides the revised planned site operations methodology to prepare for and conduct the ARM Winter SCM IOP.

2 CONCEPT OF OPERATIONS

2.1 General

The primary site operations mission for the IOP is to safely provide as much of the required data of optimum quality as humanly possible. To this end, the following concept of operations for the IOP is planned.

2.2 Planned Operations and Support

2.2.1 Central Facility

The Central Facility currently has the basic infrastructure and facilities such as buildings, utilities, lighting, and support services to support the IOP. The infrastructure support capability at the Central Facility, needs to be expanded into a 24 hour per day operation. No additional facilities requirements are necessary for this expansion, rather increased staffing and training.

2.2.1.1 Staffing

The Central Facility is currently operating in a daytime mode only with hourly weather observations, one Rawinsonde sounding per day, CF and 9 EF normal preventative and corrective instrument maintenance and sneaker net data collection, and SDS Operator Data Quality operations being performed between the hours of 8 AM and 5 PM, five days per week, including Holidays. Holiday support is provided utilizing a skeleton, two person staff of current operators in an overtime work status.

During the IOP, Rawinsonde Launches will be required once every three hours, 7 days per week, for a 21 day period. In order to support these observations, two additional work shifts will be required as follows:

2nd Shift 4:00 PM - Midnight
3rd Shift Midnight - 8:00 AM

The normal day shift will continue to support the 8:00 am - 5:00 PM period. The evening and midnight shifts will be provided through a rotating set of 3 operator sections. Each section will be comprised of two operators. Appendix A provides the shift rotation for IOP support.

Site Operations will recruit and hire 6 temporary employees to support shift work for the IOP. Advertisements will be placed in Lamont, OK and surrounding area. Training will be conducted for these temporary personnel for three working days prior to the start of the IOP.

2.2.1.2 Central Facility IOP Operations Functions

The following operations functions are planned for the IOP from the Central Facility.

A. Function as the IOP Control Center providing around the clock control and management of the CART CF and BF sites IOP activity to include:

   1. Weather Alert System Operation.

   2. Real time interface/coordination with manned Boundary Sites.

3. Safety and Emergency situation and status management and reporting for the CF and all BF's.

4. IOP Logistics support for the CF and all BF's.

B. Preparation and conduct of Rawinsonde launches once every three hours.

C. Hourly weather observations 24 hours/day.

D. SDS Data Quality Operations (SDS Operations) 24 hours/day.

E. Routine and event required Site Operations Log IOP status entries.

F. CF Instrument checks for instruments not visible on the SDS to include AERI, SORTI, WSI, Belfort Ceilometer, performed once each shift as required.

G. Perform manual filling of liquid nitrogen cooled instruments as required during the 24 hours period to ensure continuous sensor cooling.

H. As required adjustments of BSRN shadow arms.

I. Continued normal daily CF work to include visitors, shipping receiving, telephone coordination, administration, procurement, documentation, and reporting.

2.2.2 Boundary Facilities

2.2.2.1 Site Locations and Facilities

The optimum planned locations for the SGP CART permanent Boundary Sites are close to the NOAA 404 Wind Profiler sites at Hillsboro, Kansas, and Morris, and Vici, Oklahoma. An initial Permanent Boundary Site Construction Specification plan was developed during September identifying the planned facilities requirements for the permanent sites. After review of the extensive BF site development requirements, it became clear that implementation of the full facility configuration was not achievable by the start of the planned Winter SCM IOP.

Due to logistics considerations, it has been decided to place the BF Sonde Trailers at the NOAA 404 locations.

2.2.2.2 Buildings/Services

Each of the temporary BF locations will be operated from the BF Trailers, as the only manned facility. The planned method of preparing and moving these trailers to the BF locations is a follows:

Preparation:

The following equipment will be installed in each railer prior to moving to the BF location.

A. Furniture, Office Equipment, and Supplies

Each trailer will be fitted with two commercial metal frame desks with sufficient work surface and drawer storage. Each trailer will be fitted with two office chairs with casters, office supplies, two commercial telephone lines (one voice, one data),and one cellular telephone for emergency backup use.

B. Safety Equipment

Each trailer will be fitted with a First Aid Kit, Fire Extinguisher, Eye Wash Station, and appropriate safety signs. Safety training on the use of this safety equipment, and handling of pressurized helium cylinders will be provided.

C. Computer/Communications Equipment

Each trailer will have the following computer and communications equipment installed prior to moving.

1. Uninterruptable Power Supply.
2. Vaisala DIGI-CORA Rawinsonde System including modem and floppy disk drive.
3. Sun Sparc Station.
4. Serial Mux
5. Cabletron communications interface.

D. Meteorological Instruments

A set of basic meteorological parameter measuring instruments is being procured for installation at each trailer, to include wind speed/direction, temperature, humidity, and barometric pressure. These instruments can be use to validate sonde transmitter operation, and also support hourly weather observations.

Moving:

A. Each of the three trailers will be towed to the applicable temporary BF locations utilizing the site GSA pickup which has been fitted with the required towing equipment and electrical connections. A sufficient amount of Rawinsonde supplies (transmitters, parachutes, etc) will be stored and moved within the trailers.

Setup:

A. Each of the trailers will be parked at the appropriate site, leveled, and temporarily tied down.

B. Arrangements for and connections to available 220 VAC power will be made.

C. Arrangements for and connections to a phone line will be made.

D. Arrangement for and initial supplies of helium will be delivered and stored at the temporary BF location.

E. Depending upon local services available, we may also require that a portable toilet and water supply (bottled water) be provided at the temporary site.

F. After initial setup, activation of computer equipment, and general setup/checkout of Rawinsonde equipment will be performed. In addition, the required communications connectivity with the SDS for data transfer will be setup and tested.

G. There may also be a requirement to implement MWR instruments at each of the temporary BFs. If this requirement becomes firm, then the appropriate moving, setup, and connection of the instruments to the BF SDS equipment would also need to be accomplished.

2.2.2.3 BF Operations

2.2.2.3.1 IOP Routine Operations

IOP operations will require 24 hour per day support for Rawinsonde launches scheduled for once every three hours during the 21 day period. Since the site will be manned continuously, value added services will include hourly weather observations, site operations log entries, BF communications with site operators will be required. Daily cleaning of the MWR sensor cover will also be performed if the instruments are deployed.

All three BF's will be manned 24 hours per day during the IOP by implementing a rotating 4 section shift work schedule to cover the day, evening, and midnight shifts. Each section will consist of one site operator to perform the duties defined below. Appendix B provides a sample of the work schedule for all BF's.

2.2.2.3.2 Safety and Emergency Actions

Each of the temporary site locations will be coordinated with local site authorities to include Police, Fire, and Medical Services. All BF Operators will be trained in the interface methods, and the use of the site safety equipment. Routine and emergency coordination will be provided through telephone and SDS email with the Central Facility Control Center.

Since the temporary sites may or may not provide severe weather or weather warning personnel protection facilities, the BF site will be evacuated upon placement of the site in a weather warning condition red status. The Central Facility Control Center will provide weather forecasts and warnings for the Boundary Sites. Specific site evacuation plans and procedures will be developed and provided for each site. It is anticipated that local people will be hired. When the site is evacuated, personnel will be expected to go home and check in with the Central Facility Control Center for notification that they have arrived home safely. They will be contacted when conditions are safe to return to the work site.

2.2.2.4 BF Staffing

It has been decided to have Site Operations recruit and hire temporary personnel to operate the Boundary Sites in a "Campaign Mode" until budget issues become resolved. After analysis it is planned to operate each BF with one operator (person) per 8 hour shift. This concept will require a Safety Analysis and Procedure to allow for what if scenarios. To this end, Site Operations plans to perform the following:

A. Advertise in the local area newspapers of Vici, OK, Morris, OK, and Hillsboro, KS.

B. Provide employment applications via mail to all candidates who respond to the newspaper adds.

C. Schedule and travel to each site location and conduct interviews and hire five Temporary Employees for each BF Site (4 IOP Operators plus one alternate). Preference will be given to candidates that are from the BF immediate area. Candidates will not actually start work until 3 working day prior to the start of the IOP.

D. Schedule, coordinate, travel, and conduct operator training for each site simultaneously, at the BF, utilizing existing site personnel, for a three day period.

E. After instrument and safety training, and assessment of readiness, support the 21 day IOP. Upon completion of the IOP, terminate the temporary employees. Records to be retained for future IOP support as appropriate and possible.

Permanent CF site operations staff will provide the following support for activation of the BF's.

A. Complete installation of all designated equipment in the trailers while the trailers are still at the Central Facility.

B. Move the trailers and supervise the setup and activation of each of the Boundary sites, including helium supplies.

C. Coordinate and supervise the on site training of the personnel designated for each of the BF's.

D. Prepare for and conduct an Operational Integrated multi site Systems Test utilizing CIMMS personnel.

E. Assess the readiness of each BF site and personnel to conduct IOP operations, and coordinate this readiness with the Central Facility IOP Control Center.

F. If required, travel to and make repairs to failed equipment.

2.2.2.5 BF IOP Operations Functions

During the IOP, the following operational tasks will be performed:

A. Prepare for and conduct Rawinsonde launches once every 3 hours. Save, install, and ensure data collection and transfer in accordance with established methods.

B. Conduct hourly weather observation in the same format as currently used at the Central Facility.

C. Perform routine and frequent check-in with the Central Facility IOP Control Center, providing current status of BF operations.

D. Maintain all required station logs and reports.

E. Enter routine and non-routine site status messages into the BF SDS SOL

3 SCM IOP OPERATIONS CONSIDERATIONS

3.1 Scheduled Start Date

Assuming all logistics issues are complete, and favorable weather conditions exist, the Winter SCM IOP is tentatively scheduled to start at 0800 CST January 10, 1994.

3.2 IOP Shut Downs

The mission goal for the Winter SCM IOP is 21 consecutive days of successful Rawinsonde launches from three Boundary Sites. There may be periods during the 21 day operation where a single, or multiple sites experience brief to extended conditions when launches are not possible. Through coordination between the Site Program Manager, Site Scientist, and Site Operations Manager, the following shut down and restart criteria have been established:

A. A single site failure which will result in the loss of 4 or more consecutive Sonde launches is the threshold for stopping the IOP at all sites. Conditions which may produce this condition include severe weather (winter storm), electric power loss, and Rawinsonde equipment failure.

   Should this condition become imminent, an emergency coordination meeting will be called between the Site Program Manager and the Site Operations Manager to discuss the situation and make the decision to shut down the exercise. After the decision is made, Site Operations will notify all sites of the shut down. All IOP activity and Temporary Site Operator Personnel will be placed in a stop work status. Continuous coordination between the Site Program Manager and the Site Operations Manager will result in the decision to re-start or terminate the IOP.

B. Should the Central Facility experience or be forecasted to experience any shut down exceeding 12 consecutive hours, the IOP will also be shut down. Emergency coordination between the Site Program Manager and the Site Operations Manager will assess and determine the potential for re-start or if the outage is severe, the decision to terminate the IOP. Upon making the decision for IOP shut down, Site Operations will notify all site personnel. All IOP activity and Temporary Site Operator personnel will be placed in a stop work status until the decision is made to re-start or terminate the IOP.

C. If the shut down is an emergency condition situation, every effort will be made to gracefully shut down the affected facility. However, the safety of personnel takes precedence and if the shut down requires immediate evacuation, the graceful shut down may not be possible. The responsible site operators will return to the site after the danger condition passes, and effect a graceful shut down of the site.

3.3 Restart

Should the IOP be temporarily stopped, and the decision is made to restart the exercise, Site Operations at all site will commence with the start of the next scheduled work shift (i.e., if the shut down is for 24 hours, and starts in the middle of the evening shift, the restart would occur with the start of the mid shift the following day.

3.4 IOP Termination

As discussed above, and based upon the criteria of forecasted extended outage at one Boundary Facility, the decision to terminate the IOP may be made. Once the decision is made to terminate the IOP, the graceful shut down of the Boundary Facilities will be accomplished based upon the procedures in the Boundary Facility Site Operator Manual.

Appendix B

ARM PROGRAM
SOUTHERN GREAT PLAINS
CLOUDS AND RADIATION TESTBED SITE

SITE OPERATIONS

SPRING INTEGRATED IOP

IMPLEMENTATION PLAN

Final

March 24, 1994

Revision 6

1 INTRODUCTION

A major SGP CART Program milestone is currently scheduled to occur in April 1994. This milestone is the integration of several IOPs: the second seasonal SCM IOP, the Cloud Remote Sensing (RCS) IOP that is a mix of IDP instruments and instruments of opportunity, and the UAV IOP.

This document is the planning document for site operations that integrates all of these IOPs into a set of highly structured operational procedures. Each of the IOPs are different, affecting shut down and start up requirements, data needs and requirements, individualized miscellaneous support.

Schedules require that the Integrated IOP will consist of a 21 day period, and will require 24 hour per day, 7 days per week operations personnel support from the Central Facility and three Boundary Facilities, to receive rawinsonde support. Rawinsonde launches are planned for once every three hours from all four Facilities during the Integrated IOP, as well as ensuring that all other CART site instruments are at optimal performance during the exercise period.

In order to achieve this significant program milestone, substantial planning is required, and the time remaining to implement the necessary Integrated IOP operations support is limited. This document provides the planned site operations methodology to prepare for and conduct the Integrated IOP.

2 CONCEPT OF OPERATIONS

2.1 General

The primary site operations mission for the Integrated IOP is to safely provide as much of the required data of optimum quality as humanly possible. To this end, the following concept of operations for the integration of the SCM, RCS, and UAV IOPs is planned.

2.2 Planned Operations and Support

This section will describe the independent needs of the SCM, RCS, and UAV IOPs. Most of the operational requirements of the Integrated IOP are to provide for the SCM IOP, since this IOP requires round the clock operations for rawinsonde launches. This imposes significant manpower requirements and operational procedures that were addressed for the Winter SCM IOP. Since appropriate operational documentation already exist and can be found in the Boundary Site Operational Manuals, those details are not repeated here.

2.2.1 Spring SCM IOP

2.2.1.1 Central Facility

The Central Facility currently has all the basic infrastructure and facilities such as buildings, utilities, lighting, and support services to support the SCM IOP.

2.2.1.2 Staffing

The Central Facility is currently operating in a daytime mode only with hourly weather observations, one Rawinsonde sounding per day, CF and servicing 9 EFs with normal preventative and corrective instrument maintenance and sneaker net data collection, and SDS Operator Data Quality operations being performed between the hours of 8 AM and 5 PM, five days per week, including Holidays. Holiday support is provided utilizing a skeleton, two person staff of current operators in an overtime work status. Rawinsonde launches are the driver for the SCM IOP.

During the SCM IOP, Rawinsonde Launches will be required once every three hours, 7 days per week, for a 21 day period. In order to support these observations, two additional work shifts will be required as follows:

2nd Shift 4:00 PM - Midnight
3rd Shift Midnight - 8:00 AM

The normal day shift will continue to support the 8:00 am - 5:00 PM period. The evening and midnight shifts will be provided through a rotating set of 3 operator sections. Each section will be comprised of two operators.

2.2.1.3 Central Facility SCM IOP Operations Functions

The following operations functions are planned for the SCM IOP from the Central Facility.

A. Function as the SCM IOP Control Center providing around the clock control and management of the CART CF and BF sites, which includes:

1. Weather Alert System Operation.

2. Real time interface/coordination with manned Boundary Sites.

3. Safety and Emergency situation and status management and reporting for the CF and all BF's.

4. SCM IOP status/coordination support for the CART and pre-arranged IDP instruments, CF and all BF's. This includes the provision for daily weather briefings, summaries of daily activities, and status of instruments and systems.

B. Preparation and conduct of Rawinsonde launches once every three hours.

C. Hourly weather observations 24 hours/day.

D. SDS Data Quality Operations (SDS Operations) 24 hours/day.

E. Routine and event required Site Operations Log IOP status entries.

F. CF Instrument checks for instruments not visible on the SDS to include MPL, AERI, SORTI, WSI, Belfort Ceilometer, the 50 and 915 MHz profiles and RASS systems, performed once each shift as required.

G. Perform manual filling of liquid nitrogen cooled instruments as required during the 24 hours period to ensure continuous sensor cooling.

H. As required adjustments of BSRN shadow arms.

I. Continued normal daily CF work to include visitors, shipping receiving, telephone coordination, administration, procurement, documentation, and reporting.

2.2.1.4 Boundary Facilities

2.2.1.4.1 Site Locations and Facilities

The locations for the SGP CART permanent Boundary Sites are close to the NOAA 404 Wind Profiler sites at Hillsboro, Kansas, and Morris and Vici, Oklahoma. Details are given in the Boundary Site Operator's Manuals.

2.2.1.4.2 Buildings/Services at BF locations

Each of the temporary BF locations will be operated from the BF Trailers. These are described elsewhere in the Boundary Site Operator's Manuals.

2.2.1.4.3 BF Operations

2.2.1.4.3.1 Integrated SCM IOP Routine Operations

SCM IOP operations will require 24 hour per day support for Rawinsonde launches scheduled for once every three hours during the 21 day period. Since the site will be manned continuously, value added services will include hourly weather observations, site operations log entries, BF SDS operations, and keeping of other required station logs. Routine telephone status communications with site operators will be required. Daily cleaning of the MWR sensor cover will also be performed if the instruments are deployed.

All three BF's will be manned 24 hours per day during the IOP by implementing a rotating 4 section shift work schedule to cover the day, evening, and midnight shifts. Each section will consist of one site operator to perform the duties defined below.

2.2.1.4.3.2 Safety and Emergency Actions

Each of the BF locations will be coordinated with local site authorities to include Police, Fire, and Medical Services. All BF Operators will be trained in the interface methods, and the use of the site safety equipment. Routine and emergency coordination will be provided through telephone.

Since the BF sites may or may not provide severe weather or weather warning personnel protection facilities, the BF site will be evacuated upon placement of the site in a weather warning condition red status. The Central Facility Control Center will provide weather forecasts and warnings for the Boundary Sites. Specific site evacuation plans and procedures will be developed and provided for each site. It is anticipated that local people will be hired. When the site is evacuated, personnel will be expected to go home and check in with the Central Facility Control Center for notification that they have arrived home safely. They will be contacted when conditions are safe to return to the work site.

2.2.1.4.3.3 BF Staffing

Site Operations will recruit and hire temporary personnel to operate the Boundary Sites during the SCM IOP, in accordance with the Boundary Site Operator's Manuals.

2.2.1.5 Boundary Facility SCM IOP Operations Functions

During the IOP, the following operational tasks will be performed:

A. Prepare for and conduct Rawinsonde launches once every 3 hours (03, 06, 09, 12, 15, 18, 21, and 24 Z). Save, install, and ensure data collection and transfer in accordance with established methods.

B. Conduct hourly weather observation in the same format as currently used at the Central Facility.

C. Perform routine and frequent check-in with the Central Facility IOP Control Center, providing current status of BF operations.

D. Maintain all required station logs and reports.

E. Enter routine and non-routine site status messages into the BF SDS SOP

2.2.2 Spring RCS IOP

All activities associated with the RCS IOP will take place at the Central Facility.

2.2.2.1 Site Locations and Facilities

The optimum planned locations for the RCS instruments will be at one of three IDP areas at the central facility. IDP #1 (between the Calibration Trailer and the Aerosol Trailers) have electrical and phone hookups for 2 trailer facilities. IDP #2 (nearest the Optical Trailer) has electrical and phone hookups for 3 trailer facilities. IDP #3 (located about 100 m east of the

Staging Trailer) has electrical and phone hookups for 3 trailer facilities. In addition, a limited number of instruments may be set up in appropriate trailers at the Central Facility.

2.2.2.2 Buildings and Services

It is assumed that RCS instruments will either be operated from their own mobile trailers or utilize space in existing central facility trailers.

A. Preparation:

The following equipment is available at the central facility to be installed in the Optical and Staging Trailers trailer prior to RCS IOP.

1. Furniture, Office Equipment, and Supplies.

Each central facility trailer can be fitted with commercial metal frame desks with sufficient work surface and drawer storage. Each trailer can be fitted with office chairs with casters, office supplies, commercial telephone lines (voice only),and one cellular telephone for emergency backup use.

2. Safety Equipment.

Each of the 7 permanent Central Facility Trailers are fitted with a First Aid Kit, Fire Extinguisher, Eye Wash Station, and appropriate safety signs. Safety training on the use of this safety equipment, and handling of pressurized helium cylinders will be provided, if required. The Site Safety Officer will conduct a training orientation that will outline the proper procedures for using the safety equipment at the site.

3. Computer/Communications Equipment.

ARM Policy is that IDP instruments are not interfaced with the SDS. Only site operators can interface with the SDS. All data requests will have to go through ARM data management for approval. Because of the limitations of the SDS, only limited requests can be honored. Data requests will be reviewed by the EST for consideration and feasibility of support requirements. The actual distribution of the data will be the responsibility of the DMT.

4. IDP #3 is the only location planned for 3-phase power. The planning and implementation of this activity is scheduled to be ready by April 1.

5. An all weather access to IDP #3 is being planned and will be ready by April.

6. Each of the IDP areas will have electrical and phone hookups for the appropriate number of mobile trailers. This activity is currently being planned and will be ready by April.

7. The site experiences numerous power fluctuations per day, for periods of seconds to 10's of seconds. We strongly recommend that all sensitive equipment be connected to an Uninterruptable Power Supply, to be supplied by RCS experimenters.

B. Moving:

1. Each of the RCS IOP mobile trailers will be assigned to an IDP area. It is the responsibility of the RCS experimenters to get their trailers or equipment to the

assigned areas.

2. The location of the mobile trailers needs to be carefully managed because of potential interferences with CART instruments and with each other. This is an ongoing activity.

C. Setup:

1. Each of the trailers will be parked at the appropriate site, leveled, and temporarily tied down.

2. Arrangements for connections to available power and phone will be made by site operations and a certified electrician. It is the policy of the site that ALL ELECTRICAL WORK WILL BE CONDUCTED AT THE SITE WILL BE DONE WITH ELECTRICAL POWER SYSTEMS DEENERGIZED. ALL HOOKUPS TO ELECTRICAL SYSTEMS REQUIRE INSPECTION BY A CERTIFIED ELECTRICIAN.

3. Arrangements for and initial RCS instrument supplies that require delivery to the site will be coordinated by site operations.

4. Site Operations will provide for a portable toilet and water supply (bottled water) at IDP #2.

5. After initial setup, general setup/checkout of RCS equipment will be performed. In addition, phone (both cellular and/or commercial) procedures will be explained. Although outside lines can be programmed to individual locations, the number of physical phone lines in and out of the site are very limited. The phones are also paging and intercom systems that can be used to locate and communicate with anyone on the site. Any of the IDP areas

6. During the general checkout phase, each RCS experimenter will be required to provide a familiarization briefing and inspection of their respective equipment to Site Operations Personnel. Any safety or operational concerns will be identified during this inspection and risk mitigation methods discussed.

7. Parking is extremely limited at the central facility. All personnel using IDP areas #1 and #2 will be asked to park in the parking lot after initial setup. Vehicular traffic on the central facility is restricted.

8. Minimal parking space will be provided at IDP area #3. Carpooling is strongly encouraged.

9. At this time, electrical connections between mobile trailers and patch panels at IDP locations will be standardized. It is assumed that each mobile has an umbilical power cord. ARM will provide a standardized male ARC-Type connector for a determined amperage size. Each mobile trailer will have an additional 3 or 4 GCFI outlets on the patch panel for use. Each mobile trailer will have its own patch panel. Also, a phone connection will be provided.

10. RCS experimenters will provide the mobile trailer facility for their equipment to be placed at the IDP areas. Limited trailer space at fixed locations at the Central Facility are available.

2.2.2.3 RCS IOP Operations

2.2.2.3.1 RCS IOP Routine Operations

RCS IOP operations will require 24 hour per day support for Rawinsonde launches scheduled for once every three hours during the 21 day period. Since the site will be manned continuously, value added services will include hourly weather observations, site operations log entries, and keeping of other required station logs.

Although RCS operations are an independent activity at the site with manpower supplied by the experimenters, coordination and interface with the site operations will be required. RCS experimenters will provide site operations with a SOP of individual RCS operations.

Site operations will coordinate and in some cases provide for expendables for RCS activities.

Site operations will provide daily oversight of all on-site operations of RCS participants to assure compliance of OSHA, DOE, and ANL rules and regulations that govern the SGP CART Site.

2.2.2.3.2 Safety and Emergency Actions

Each of the temporary site locations will be coordinated with local site authorities to include Police, Fire, and Medical Services. All RCS experimenters will be trained by the Site Safety Officer in the interface methods, and the use of the site safety equipment. Routine and emergency coordination will be provided through the Site Operations Manager (Jim Teske) and the Site Safety Officer (John Schatz). All accidents, injuries (minor or otherwise) MUST BE REPORTED TO THE SITE SAFETY OFFICER.

All non-essential personnel at the site will be evacuated upon placement of the site in a weather warning condition red status. The Central Facility Control Center will provide weather forecasts and warnings for the Integrated IOP participants. Specific site evacuation plans and procedures will be developed and provided for each IDP location.

Two storm shelters on the site have capacity for about 40-50 people. Priority is given to site operations personnel, then others. If we exceed capacity of the shelter, and when the site goes to a severe weather warning condition, all non-essential personnel will be asked to evacuate the site.

When the site is evacuated, personnel will be expected to go their place of lodging and check in with the Central Facility Control Center for notification that they have arrived safely. They will be contacted when conditions are safe to return to the work site.

A. The Site Safety Officer has the responsibility and authority to immediately shut down any activity that is defined by OSHA, DOE, and ANL to be eminent danger (life-threatening).

B. Situations that are considered to be high risk potential for injury will be immediately brought to the attention of appropriate personnel. Corrective actions may be required before work will be allowed to continue.

C. Any personnel variance granted by the Site Safety Officer will be indicated by the badge worn by the individual granted the variance.

D. All hazardous waste will be disposed of in accordance with OSHA, DOE, and ANL policy. Site operations will coordinate and provide services for this function.

2.2.2.3.3 RCS Experimenter Staffing

Site Operations will require a list of all personnel associated with each RCS and UAV facility. This includes name, affiliation, where they can be reached at place of lodging, and emergency phone number.

A. Visitor ID tags will be issued and are to be worn at all times when on site.

B. An site orientation is required of all personnel involved with the Integrated IOP.

C. Daily sign-in and sign-out of all participants is required.

D. Appropriate clothing must be worn on site. No shorts, no tank tops, and only appropriate safe shoes. Depending on the activity, steel-toed shoes may be required.

E. The is a smoking only in designated areas and appropriate waste disposal locations.

2.2.2.3.4 RCS Operations Functions

A. Daily Briefings/Coordination Meetings will be conducted by the RCS IOP Scientist. One or more representatives from each RCS facility will be appointed to attend daily meetings and weather briefing. The meeting place will be the kitchen area of the Staging Trailer. At this meeting, a weather briefing will be given. Also, each representative will be given a few minutes to report on the status of their operation that day. These meetings will be recorded and minutes provided to all experimenters.

B. The On-Site Manager, Jim Teske, is responsible for all on-site activities and personnel at the SGP CART Site and has the local authority to act in behalf of the Site Program Manager in manners of operational activities at the site.

2.2.3 Spring UAV IOP

Most of the UAV IOP activities and facilities are to be located at the Blackwell/Tonkowa Airport. However a set of radiometers will be placed at the Central Facility for the period of the UAV IOP.

2.2.3.1 Site Locations and Facilities

The UAV IOP requires communication between the Central Facility and the Blackwell/Tonkowa Airport. Phone communication will be used. Only a set of NASA/AMES radiometers will be placed at the Central Facility.

2.2.3.2 Buildings and Services

All furniture and storage requirements are met by setting up radiometer related equipment in the Optical Trailer. One desk and chair will be required for the UAV IOP radiometer equipment.

Because power fluctuations and brown-outs are numerous, UAV IOP personnel is strongly advised to provide an Uninterruptable Power Supply for their sensitive electronic equipment.

UAV IOP personnel are responsible for the setup and operation of the radiometers. Twenty-four hour access to the site is available ONLY during the Integrated IOP activity.

2.2.3.3 UAV IOP Routine Operations

UAV IOP operations will require 24 hour per day support for Rawinsonde launches scheduled for once every three hours during the 21 day period. Since the site will be manned continuously, value added services will include hourly weather observations, site operations log entries, and keeping of other required station logs.

Although UAV operations are an independent activity at the site with manpower supplied by the experimenters, coordination and interface with the site operations will be required. UAV experimenters will provide site operations will a outline of UAV operations.

Site operations will coordinate and in some cases provide for expendables for UAV activities.

Site operations will provide daily oversight of all on-site operations of UAV participants to assure compliance of OSHA, DOE, and ANL rules and regulations that govern the SGP CART Site.

2.2.3.4 Safety and Emergency Actions

Each of the temporary site locations will be coordinated with local site authorities to include Police, Fire, and Medical Services. All RCS experimenters will be trained by the Site Safety Officer in the interface methods, and the use of the site safety equipment. Routine and emergency coordination will be provided through the Site Operations Manager (Jim Teske) and the Site Safety Officer (John Schatz). All accidents, injuries (minor or otherwise) MUST BE REPORTED TO THE SITE SAFETY OFFICER.

All non-essential personnel at the site will be evacuated upon placement of the site in a weather warning condition red status. The Central Facility Control Center will provide weather forecasts and warnings for the Integrated IOP participants. Specific site evacuation plans and procedures will be developed and provided for each IDP location.

The storm shelters on the site have capacity for about 40 people. Priority is given to site operations personnel, then others. If capacity of the shelters is exceeded, when the site goes to a severe weather warning condition, all non-essential personnel will be asked to evacuate the site.

When the site is evacuated, personnel will be expected to go their place of lodging and check in with the Central Facility Control Center for notification that they have arrived safely. They will be contacted when conditions are safe to return to the work site.

A. The Site Safety Officer has the responsibility and authority to immediately shut down any activity that is defined by OSHA, DOE, and ANL to be eminent danger (life-threatening).

B. Situations that are considered to be high risk potential for injury will be immediately brought to the attention of appropriate personnel. Corrective actions may be required before work will be allowed to continue.

C. Any personnel variance granted by the Site Safety Officer will be indicated by the badge worn by the individual granted the variance.

D. All hazardous waste will be disposed of in accordance with OSHA, DOE, and ANL policy. Site operations will coordinate and provide services for this function.

2.2.3.5 UAV Experimenter Staffing

Site Operations will require a list of all personnel associated with UAV instruments at the Central Facility. This includes name, affiliation, where they can be reached at place of lodging, and emergency phone number.

A. Visitor ID tags will be issued and are to be worn at all times when on site.

B. An site orientation is required of all personnel involved with the UAV IOP.

C. Daily sign-in and sign-out of all participants is required.

D. Appropriate clothing must be worn on site. No shorts, no tank tops, and only appropriate safe shoes. Depending on the activity, steel-toed shoes may be required.

E. The is a smoking only in designated areas and appropriate waste disposal locations.

2.2.3.6 UAV Operations Functions

A. Daily Briefings/Coordination Meetings will be conducted by the RCS IOP scientist. One representative from each RCS facility will be appointed to attend daily meetings and weather briefing. The meeting place will be the kitchen area of the Staging Trailer. At this meeting, a weather briefing will be given. Also, each representative will be given a few minutes to report on the status of their operation that day. These meetings will take place at the Aerosol Trailer at the Central Facility and at an off-site location still to be determined.

B. The On-Site Manager, Jim Teske, is responsible for all on-site activities and personnel at the SGP CART Site and has the local authority to act in behalf of the Site Program Manager in manners of operational activities at the site.

3 INTEGRATED IOP OPERATIONS CONSIDERATIONS

3.1 SCM IOP

3.1.1 Scheduled Start Date

Assuming all logistics issues are complete, and favorable weather conditions exist, the start of the Spring Integrated is tentatively scheduled for April 11, 1994 through May 1, 1994.

3.1.2 SCM IOP Shut Downs

The mission goal for the Spring SCM IOP is 21 consecutive days of successful Rawinsonde launches from three Boundary Sites. There may be periods during the 21 day operation where a single, or multiple sites experience brief to extended conditions when launches are not possible. Through coordination between the Site Program Manager, Site Scientist, and Site Operations Manager, the following shut down and restart criteria have been established:

A. A single site failure which will result in the loss of 4 or more consecutive Sonde launches is the threshold for stopping the IOP at the BF sites. Conditions which may produce this condition include severe weather (winter storm), electric power loss, and Rawinsonde equipment failure.

Should this condition become imminent, an emergency coordination meeting will be called between the Site Program Manager and the Site Operations Manager to discuss the situation and make the decision to shut down the exercise. After the decision is made, Site Operations will notify all sites of the shut down. All IOP activity and Temporary Site Operator Personnel will be placed in a stop work status. Continuous coordination between the Site Program Manager and the Site Operations Manager will result in the decision to re-start or terminate the SCM IOP.

B. Should the Central Facility experience or be forecasted to experience any shut down exceeding 12 consecutive hours, the SCM IOP will also be shut down. Emergency coordination between the Site Program Manager and the Site Operations Manager will assess and determine the potential for re-start or if the outage is severe, the decision to terminate the IOP. Upon making the decision for IOP shut down, Site Operations will notify all site personnel. All SCM IOP activity and Temporary Site Operator personnel will be placed in a stop work status until the decision is made to re-start or terminate the IOP.

C. If the shut down is an emergency condition situation, every effort will be made to gracefully shut down the affected facility. However, the safety of personnel takes precedence and if the shut down requires immediate evacuation, the graceful shut down may not be possible. The responsible site operators will return to the site after the danger condition passes, and effect a graceful shut down of the site.

3.1.3 SCM IOP Restart

Should the SCM IOP be temporarily stopped, and the decision is made to restart the exercise, Site Operations at all BF sites will commence with the start of the next scheduled work shift (i.e., if the shut down is for 24 hours, and starts in the middle of the evening shift, the restart would occur with the start of the mid shift the following day.

3.1.4 SCM IOP Termination

As discussed above, and based upon the criteria of forecasted extended outage at one Boundary Facility, the decision to terminate the SCM IOP may be made. Once the decision is made to terminate the IOP, the graceful shut down of the Boundary Facilities will be accomplished based upon the procedures in the Boundary Facility Site Operator Manuals.

3.2 RCS IOP

Each RCS experimenter operational requirements must be assessed to determine dependence operations on other information or instruments. We need this information to make appropriate decisions about operational days for the RCS IOP.

3.2.1 RCS IOP Scheduled Start

Scheduled start date is tentatively scheduled for April 11 through May 1, 1994.

3.2.2 RCS IOP Shut Down

Requirements will be determined.

3.2.3 Severe Weather

There is limited space in the tornado shelter. All non-essential personnel will be evacuated from the site when such conditions arise. This is the geometric center tornado alley. SGP CART personnel are considered essential personnel.

3.2.4 RCS IOP Restart

The On-Site Program Manager and the Site Safe Officer will make the determination of when it is safe to resume RCS IOP activities at the Central Facility after a shut down.

3.2.5 RCS IOP Termination

Twenty-four hour, 7 days per week operations will continue only for the period of the SCM IOP. After that time, site operations are 8 AM to 5 PM, Monday through Friday. Access to the site is only during site operations hours.

3.3 UAV IOP

3.3.1 UAV Scheduled Start

Scheduled start date is April 4-23, 1994. This is a fixed time frame for activities of the UAV IOP.

3.3.2 UAV Shut Down

UAV IOP shut down will be determined by UAV IOP personnel, since it depends upon aircraft flight limitation requirements. Since UAV IOP require rawinsondes at the central facility, the status of the rawinsonde launches are the central facility may be a requirement, as well.

3.3.3 Severe Weather

If required, the Central Facility can provide information about severe weather to UAV personnel. Because the UAV IOP airport is not considered part of the SGP CART Site, personnel at the airport are responsible for their own safety. However, personnel at the Central Facility will be required to follow all safety rules.

There is adequate space in the tornado shelters at the Central Facility. In the event that personnel exceeds capacity, all non-essential personnel will be evacuated from the site when severe weather conditions arise. This is the geometric center tornado alley. SGP CART personnel are considered essential personnel.

3.3.4 UAV IOP Restart

UAV IOP restart will be determined by UAV IOP personnel.

3.3.5 UAV IOP Termination

UAV IOP termination will be determined by UAV IOP personnel.

4 FORMS

The appropriate forms should be used when interfacing with SGP CART Site. Two forms are attached and they are the Site Visit Request Form and the Shipment Notification Form. The appropriate address and phone numbers are given on these forms.